# Understanding the tensions between resilient and innovative service ecosystems: Building case studies from the New Zealand agriculture ecosystem.

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# Abstract

The New Zealand agriculture ecosystem is in an innovation slump. The New Zealand government has signalled the need to raise innovation levels to capitalise on local and global opportunities. The researcher identified that one of the potential contributors to the innovation problem is the ecosystem's inherent focus on resilience. The COVID-19 pandemic has reinforced the need to investigate the interplay between innovation and resilience as short-term solutions for resilience have come at the expense of long-term growth opportunities. Hence, there is also a need to see how organisations can innovate during a crisis to envisage future environments. Despite the rich history of innovation and resilience in the current literature, there is a limited understanding of the interplay between innovation and resilience in service ecosystems (Fehrer and Bove, 2022). Consequently, this study used the empirical setting of the agriculture ecosystem to investigate the interactions between innovation and resilience; where they are reinforcing, hindering and how the ecosystem supports the reconciliation of innovation and resilience capabilities. This study utilised an embedded comparative case study design to explore 2 cases embedded within the agriculture ecosystem—the researcher adopted a study design embedded in inductive reasoning. Fourteen exploratory interviews were conducted across a broad subset of the agriculture ecosystem, with the analysis centred on the 2 cases. Interview data was supplemented with secondary data. Analysis of the findings showed a complex and dynamic interaction between innovation and resilience. New Zealand agriculture organisations have shown to be focused on stabilising activities that inhibit the ability of the ecosystem to transform. Further the findings showed instances where innovation and resilience reinforce each other, demonstrating how organisations can create value whilst remaining resilient. This study adds to the limited literature on the interactions between innovation and resilience in service ecosystems. Further, this study adds to crisis literature by explaining how organisations can innovate during crises to enhance resilience and engage in activities that create value beyond the crisis.

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# Chapter 1: Introduction

## 1.1 Overview

New Zealand (NZ) agriculture is the centre point of the New Zealand economy. Whilst the economic performance of the agriculture ecosystem remains strong, innovation and, subsequently, productivity has and continues to remain a problem. The New Zealand productivity commission recognises that innovation is inherent to the productivity performance of NZ (New Zealand Productivity Commission, 2021a). Productivity is symbolic of innovation as it compares the primary sector inputs (land, labour, capital) relative to the performance and profitability of the ecosystem and its constituent actors (New Zealand Productivity Commission, 2021a). Over ten years to 2018, the on-farm productivity of the agriculture sector has grown at a CAGR of 3.5% (MBIE, 2020). Compared with analogous manufacturing and global peers, the sector is underperforming, signalling a problem with innovation and growth within the sector (Agritech NZ, 2020; MBIE, 2020; Teece and Brown, 2020).

Agriculture has high growth potential; however, it needs increased innovation efforts to lift up to this potential (New Zealand Productivity Commission, 2021b). Agritech NZ and MBIE have recognised the importance of agricultural technology or 'agritech' to drive innovation in the agriculture ecosystem. Agritech is critical to innovation and value creation within the agriculture ecosystem for several reasons: First, it is an essential input into primary sector industries; it is a crucial driver for increasing productivity, quality and sustainability across the entire value chain for the primary sector (Agritech NZ, 2020). The second aspect of agritech is its value as an export commodity; it accounts for approximately $1.5b in export earnings (Agritech NZ, 2020; MBIE, 2020). Thus, agritech innovation has a significant potential to contribute to the export economy. Agritech also has important implications for the broader economy, with many manufacturing and service activities in NZ relying upon the productivity of the primary sector (MBIE, 2020). Whilst agritech has enabled previous productivity gains within the ecosystem, it is yet to provide the levels of growth and value creation expected by its stakeholders (MBIE, 2020).

Despite various policy-driven approaches to increase innovation within the ecosystem, innovation has continued to lag (New Zealand Productivity Commission, 2021a). The principal challenge for agriculture organisations is to increase export revenue by increasing the value of export offerings (Agritech NZ, 2020; MBIE, 2020; MPI, 2020). This challenge is seen to be

addressed through a shift from export commodities to value-added goods and services (New Zealand Productivity Commission, 2021b). An innovative ecosystem allows organisations and NZ as a country to command a competitive advantage in overseas markets and is essential to the economic future of NZ (New Zealand Productivity Commission, 2021b).

A potential reason for the innovation problem in NZ agriculture lies in the ecosystem's inherent focus on resilience. While it is sometimes discussed as a driver for the innovation process, resilience can also hinder innovation because it can create rigid structures (Fehrer and Bove, 2022). The NZ agriculture ecosystem is the country's oldest and biggest export economy and, consequently, influenced by long-established institutional arrangements and strong path dependencies (Garund et al. 2010; Vargo and Lusch, 2016). For instance, the NZ agriculture ecosystem is integral for feeding New Zealanders and supplying the global economy with produce and value-added products. That is, the first priority of many actors in the agriculture ecosystem is to keep the food system in NZ stable and resilient to disruptions to ensure food provision and well-being for current and future generations (Summit Dialogues, n.d.). However, a strong focus on stability comes with the potential downside of failure to learn and an inability to transform (Fehrer and Bove 2022). Further, primary producers need to plan for nature-related uncertainties that may arise from land-based activities, such as natural disasters. This can lead to investments to create slack, a potential trade-off for investments in innovation (Wiliams et al., 2017). Furthermore, as the global economy has become more advanced and integrated, the degree of environmental uncertainty has increased. This has had implications for actors within the agriculture ecosystems and their strategic planning, which increasingly depends on international supply chains and efficient supply chain management (Teece et al., 2016).

The agriculture context powerfully illustrates that innovation and resilience do not always go hand in hand and that, in some cases, increases in ecosystem resilience can hinder ecosystem innovation. The COVID-19 pandemic has further exacerbated these tensions. The fast-moving disturbance caused by the pandemic forced many organizations in many industries (agriculture included) to find quick workarounds and short-term solutions (Kabadayi et al., 2020). These short-term solutions and improvisations – also referred to as crises resilience mechanisms (Fehrer and Bove, 2022) – came at the expense of missing out on long-term opportunities for growth and innovation (KPMG, 2020). This points to an interesting research

problem, namely, the limited understanding of the interplay between innovation and resilience in service ecosystems (Fehrer and Bove, 2022).

Both innovation and resilience literature streams contain similar ideas and capabilities. Further, the relationship between both concepts is predominantly described as positive in the existing studies. A prime example is the Teece et al. (1997) dynamic capabilities framework that allows decision-makers to modify their resource base to navigate environmental change (Nenonen et al., 2019). In the innovation literature, the purpose of dynamic capabilities is discussed as the ability to create and capture value through exploiting internal capabilities and exploring for new ones (Teece, 2007). Conversely, in the resilience literature, dynamic capabilities are primarily discussed in alignment with environmental disruptions and organisational survival. Capabilities associated with innovation have also been linked with resilience as new technology, knowledge and value creation patterns can be critical to the positive functioning of an organisation in response to disruption (Boin & McConnell, 2007; Nenonen & Storbacka, 2020; Teece et al., 1997; Williams et al., 2017). Normandin & Therrien (2016) also highlight adaptability and transformation, typically associated with innovation, as crucial activities that enhance resilience.

However, as stated earlier, there can be a (temporal) adverse interaction between innovation and resilience with significant effects on the adaptability of service ecosystems (or lack thereof). Williams et al. (2017), for instance, reveal a dark side of resilience whereby activities and capabilities to enhance resilience can result in decreased capabilities to engage in value creation activities due to increased rigidity. Furthermore, most resilience literature investigates the capacity to bounce back; there is a lack of literature that investigates how organisations can use their capabilities during disruptions to drive transformation and bounce forward (Fehrer & Bove, 2022).

## 1.2 Purpose and Research Question

The purpose of this thesis is *to explore the interplay of innovation and resilience capabilities in the NZ agriculture ecosystem and how these capabilities affect the shaping of this ecosystems short-term and in the long run.* Specifically, this thesis aims to shed light on the tensions and complementarities between resilience and innovation and how both concepts are related. It aims to answer the following overarching research question:

*What are the tensions between innovation and resilience in service ecosystems?*

Further, the following three sub-questions will be addressed:

- *How do resilience and innovation capabilities in the agriculture ecosystem balance themselves out/hinder each other?*
- *How do innovation and resilience capabilities in the agriculture industry reinforce each other?*
- *How does an ecosystemic perspective provide enabling and disabling structures that support the reconciliation of innovation and resilience capabilities?*

By understanding how innovation and resilience are related and under which conditions resilience hinders innovation, this thesis will propose ways forward to accelerate innovation in NZ's agriculture ecosystem.

## 1.3 Research Design and Execution

To understand the relationship between innovation and resilience, this thesis draws from a perspective of service ecosystems as complex, adaptive systems (Vargo et al., 2015) and empirical data from an embedded case study. For each case, semi-structured interviews were used to explore how organisations have been impacted by and responded to COVID-19. Interviews were conducted amongst 14 participants, reflecting a broad subset of the agriculture ecosystem. Represented organisations included: agritech providers, agriculture producers, industry bodies, professional and advisory services, funders, and research institutes. Over 13 hours of interview data were gathered. In order to triangulate findings, secondary materials were used. The secondary materials comprised over 450 pages of industry reports, industry articles, government documents and media articles. To derive the findings of this study, an inductive approach was taken. This allows the researcher to develop new concepts and ideas by firstly developing first order codes, second-order themes, and third-order dimensions (Gioia et al., 2013).

## 1.4 Contribution

This thesis contributes to both theoretical and practical knowledge. From a practical perspective, this thesis aims to provide decision-makers with a strategic framework for innovating in a crisis event, not only for survival but also to create solutions that exploit new

and emerging opportunities. Furthermore, this thesis seeks to explain how organisations within the agriculture ecosystem can interact to create value. This study also advances the understanding of the agriculture ecosystem by revealing some of the existing tensions and how they can be overcome to advance economic viability and well-being for focal actors and the ecosystem as a whole.

From a theoretical viewpoint, this research analyses innovation and resilience from a service ecosystem perspective. This allows the researcher to explicate the dynamic processes that enable and constrain innovation and allow resilience to emerge. The study uses the context of COVID-19 to look at innovation and resilience through a lens of disruption and environmental uncertainty. Fehrer & Bove (2022) highlight how major disruptions such as the COVID-19 pandemic reveal the complexity between organisations, systems and their environment. Furthermore, the COVID crisis has created a new context beyond foresight (Heinonen & Strandvik, 2021; Kabadayi et al., 2020). To date, empirical work providing insights on how to accelerate innovation capabilities in the long run, while recovering from the crises is still in its infancy, especially in sectors of primary industries. This thesis addresses this gap and provides a holistic framework that explains short-term and long-term dynamics between innovation and resilience capabilities. Further, this study extends research on the 'dark side of resilience' revealed by Williams et.al (2017).

# Chapter 2: Literature Review

Taking the practical problem above into the theoretical setting, it becomes clear that the interaction between innovation and resilience is not well understood. In order to unpack the seeming confusion and conflation between innovation and resilience, it is imperative to understand where innovation and resilience are similar and where they are distinct. The first body of literature under review in this thesis is innovation and how it unfolds from a systemic perspective. This body of literature seeks to understand the processes and capabilities by which innovation and value creation occur. The second body of literature under review is resilience. This literature body will shed light on the concept of resilience from an ecosystem perspective and reveal potential tensions and how they can be addressed. The synthesis of both literature streams will help frame the 'innovation problem' of NZ's agriculture ecosystem and present the theoretical framework for this thesis.

## 2.1 Innovation

### 2.1.1 Defining innovation

The term "Innovation" was first characterised by Joseph Schumpeter in the late 1920s (Hansen & Wakonen, 1997). Innovation defined by Schumpeter stresses the novelty aspect of innovation: a new good or a new quality of a good; a new method of production; a new market; a new source of supply; or a new organisational structure, which can be summarised as "doing things differently" (Schumpeter, 1939). Since this, innovation has been used in various disciplines and is highly fragmented across the literature (Dahesh et al., 2020; Gomes et al., 2018; Vargo et al., 2015). Innovation is commonly examined from an evolutionary economics perspective that defines innovation as the application of new ideas for a commercially beneficial outcome (Pisano & Teece, 2007). The evolutionary economics perspective typically separates producing firms from market-level innovations. From the firm's perspective, innovation is adopting new practices or ideas that will ideally help deliver growth, increased performance, and economic advantage to an entity (Pisano & Teece, 2007). This definition of innovation investigates the relationships between various aspects of organisational activities and novel ideas that generate economic value (Pisano & Teece, 2007; Porter, 1985; Teece, 1986). Conversely, from a market level perspective, innovation seeks to investigate the changing perspectives of users that facilitates the adoption of new ideas and/or solutions.

Systemic perspectives on innovation investigate how innovation arises from the interactions between multiple participants. For example, in agriculture, participants include primary producers, agritech innovators and research institutes. From a systemic perspective, innovation is defined as the evolution of new and useful knowledge (Chesbrough, 2020; Crossan & Apaydin, 2010; Vargo et al., 2015). This literature looks at purposive knowledge flows that incorporate commercially beneficial outcomes as well as non-economic aspects, for example, social and cultural outcomes (Dahesh et al., 2020). For this literature review, the researcher will use a systemic definition of innovation from an evolutionary economics point of view. This view focuses on the activities undertaken by the focal firm within a broader ecosystem to facilitate the development and commercialisation of innovations (Vargo et al., 2015).

### 2.1.2 Outcome vs process of innovation

Innovation can be framed as both an outcome and a process. Innovation outcomes relate to novel outputs (Schumpeter, 1939), new knowledge (Teece, 1986), new services (Vargo et al., 2015), new business models (Teece, 2007) and new markets (Crossan & Apaydin, 2010). Looking at innovation as an outcome investigates elements around the newness of the innovation (Crossan & Apaydin, 2010). Innovation can be new to the firm, the market or the industry in which the firm is embedded. Calia et al. (2007) emphasise that innovation is not synonymous with invention. An invention only becomes an innovation once a commercial transaction has taken place (Calia et al., 2007). This recognises the other activities required for innovation to create value and appropriate economic rents for the innovating organisation (Adner & Kapoor, 2010).

The innovation process answers questions about how innovation occurs (Crossan & Apaydin, 2010). Traditional innovation literature views the innovation process as linear flows from a supplying firm to a static market. The process starts with basic research, followed by applied R&D, then ends with the production and diffusion of the innovation (Godin, 2006). This view has separated production, consumption, technological and market elements of innovation. Furthermore, it fails to recognise the role of external actors and users in innovation and the development of markets that arise from innovative efforts (Geels, 2004; Vargo et al., 2015).

Further, innovation can be viewed as a non-linear, iterative process (Aarikka-Stenroos et al., 2014). Multiple frameworks explain the non-linear process of innovation: for instance, the Triple Helix model of Innovation (Etzkowitz & Leydesdorff, 2000), Quadruple Helix (Carayannis & Campbell, 2009), Chain Linked model (Edquist & Hommen, 1999), Open Innovation (Chesbrough, 2020; Enkel et al., 2009; Laursen & Salter, 2006) and Innovation Ecosystem (Adner & Kapoor, 2010). These frameworks have in common the co-evolution of technology and market factors that embody innovation (Aarikka-Stenroos et al., 2014). Co-evolution refers to the complex interactions among network actors (Science, Organisations, Markets), path dependencies and social and cultural factors that provide context for emerging selection pressures (Adner & Kapoor, 2010; Dahesh et al., 2020; Moore, 1993). Consequently, a firm's innovative activities are interdependent on the environments in which they embed themselves, for instance, access to labour, skills, competitive environment, and policies (Lundvall, 2007). The focus on innovation at the systemic level has extended the traditional firm-customer, innovator adopter dyad and presents an overlooked view on the role of users in innovative efforts (Vargo et al., 2015). It also outlines the interactions, interdependencies and organisational structures that are of consequence to innovation (Chandler et al., 2019; Geels, 2004; Vargo et al., 2015).

### 2.1.3 Technological innovation

The definition of innovation utilised throughout this literature review is particularly relevant for technological or knowledge-intensive innovations. In the case of agriculture, technological innovation can refer to manufacturing, biotech and digital-based solutions with the aim of creating value for organisations within the sector (MBIE, 2020). Technological change has long been a focus of innovation research; Schumpeter (1939), Porter (1985) and Teece (1986) recognised the importance of technological innovation for competitive advantage and profitability of the firm.

Technological innovation is not just crucial for the organisation, but a matter of national importance, providing the link between jobs, profit and standard of living (Baregheh et al., 2009; Lundvall, 2007). As already outlined, technological innovation is essential to primary sector productivity. Consequently, technological innovations can arise from top-down, policy-driven approaches and bottom-up entrepreneurial and organisational approaches (Carayannis & Campbell, 2009).

Technological innovation can be broken down into different elements, systems, and subsystems encompassing the creation, diffusion, and use of technology (Geels, 2004). From an R&D or knowledge creation perspective, diverse network actors such as customers, competitors, research institutes, government agencies and industry bodies can contribute to innovation development (Aarikka-stenroos & Sandberg, 2012). Lee et al. (2018) highlight the complementarity between science and technology through generating more impactful innovations and opening up new opportunities. Conversely, an overreliance on scientific knowledge can lead to a disconnect between the proposed solutions and the needs of the technological market (Lee et al., 2018). The commercialisation of the innovation typically refers to the diffusion and use of the innovation that utilises similar networks of organisational and individual actors (Aarikka-stenroos & Sandberg, 2012). Etzkowitz & Leydesdorff (2000) stress the importance of the interaction between academia, industry and the government, which facilitates the integration of knowledge producers and practitioners with complementary skillsets. Universities and governments can also facilitate the diffusion and use of innovations via policy development and broadening the social applicability of the innovation. Nonetheless, the innovation ecosystem consists of a diverse network of actors that facilitate the development and commercialisation of innovations (Aarikka-stenroos & Sandberg, 2012).

### 2.1.4 Capabilities for Innovation

Managing a firm's resources and capabilities to generate a competitive advantage is inherent in a firm's innovation strategy (Porter, 1985; Teece, 1986). A key challenge for decision-makers is identifying, developing, and deploying competencies that generate an economic advantage (Geels, 2004). Teece et al. (1997) coined the term dynamic capabilities regarding behaviours, resources and structures that enable firms to compete in dynamic environments. The dynamic capabilities framework generally refers to a forward-looking perspective that allows decision-makers to modify their resource base in response to present and future environments (Nenonen et al., 2019). Furthermore, innovation capabilities refer to the transformational nature of activities and resources that can arise from exploiting a firm's internal capabilities and exploring new capabilities (Bouncken & Kraus, 2013; Crossan & Apaydin, 2010). The capabilities utilised in innovation provide a context for the organisational structures and managerial processes that support the development and deployment of resources to create and capture value (Crossan & Apaydin, 2010; Teece et al., 1997).

An essential capability for innovation is overcoming challenges that may present themselves in the innovation process. The novelty aspect of innovations, particularly with radical, technological and discontinuous innovations, presents a challenge and often requires other innovations to support the development and commercialisation of the focal innovation (Adner & Kapoor, 2010). Consequently, the value created from a focal innovation is dependent on the ability of other actors in the ecosystem to innovate to accommodate novel solutions (Adner & Kapoor, 2010). Adner & Kapoor (2010) propose that the specific positioning of challenges (upstream or downstream of the innovation) can have different implications for value creation and organisational learning. Upstream or component challenges constrain the firm's ability to develop its innovation. In contrast, downstream or complement challenges reduce the perceived value to users by the focal innovation (Adner & Kapoor, 2010).

In high tech industries such as automation or science-based innovation, value creation from technological innovation arises from a combination of capabilities. Technological superiority in isolation is not enough for an innovation to be successful (Mohr & Sarin, 2009). Similarly, organisations with strong marketing capabilities will fail to overcome development challenges associated with a lack of technological expertise (Mohr & Sarin, 2009). Dutta et al. (1999), as cited by (Mohr & Sarin, 2009), indicate that firms with a strong technological base have the most to gain from marketing capabilities. For example, science-based innovations often provide solutions that do not address the demand of the technological market. Market orientation is one kind of marketing capability that provides a source of ideas for technological innovations that will create value for customers and address market needs (Mohr & Sarin, 2009). Nenonen et al. (2019) presents an argument for the importance of market-shaping capabilities, in addition to sensing capabilities, as a way of creating new business opportunities. This is particularly important with radical innovations that present a degree of novelty and consequently introduce high levels of uncertainty and complexity (Nenonen et al., 2019). O'Connor and Rice (2013), as cited by (Nenonen et al., 2019), point out that most radical innovations fail due to the lack of capabilities to create or transform markets. Firms can utilise market-shaping capabilities as purposive actions to influence market-level characteristics and link stakeholder resources in novel ways to prepare the market for their innovation (Nenonen et al., 2019). Consequently, a combination of market and technological capabilities are needed for maximal value creation within high tech industries (Aarikka-stenroos & Sandberg, 2012).

Innovator firms must also possess relational capabilities to operate within cooperative networks that provide supporting resources and complementary technologies to facilitate innovation development, diffusion and use (Aarikka-stenroos & Sandberg, 2012). Calia et al. (2007) highlight relational capabilities as particularly important where technological complexity demands a broad integration of specialised skills and knowledge. For example, small science and technology-based organisations are crucial elements in the ecosystem for contributing new knowledge and inventions (Bouncken & Kraus, 2013; Neyens & Leuven, 2010; Partanen et al., 2014). Small organisations are often a source of radical or disruptive innovation, adopted by larger organisations that do not possess the capabilities to engage in such activities themselves (Bouncken & Kraus, 2013). Startups and smaller organisations also lack the resources to independently develop and commercialise their knowledge. Because of this, they typically utilise network relationships to complement their resource base and facilitate the credibility and adoption of their innovations (Partanen et al., 2014). Bouncken and Kraus (2013) introduce the term coopetition, where organisations utilise synergistic effects from pooling resources to compete with organisations in different knowledge and innovation networks. Coopetition is particularly important for small markets such as NZ agriculture, where domestic competition can stifle collaboration (New Zealand Productivity Commission, 2020). The resources and activities of network actors are essential for developing innovations and their subsequent commercialisation (Aarikka-stenroos & Lehtimäki, 2014; Aarikka-stenroos & Sandberg, 2012). Although, the necessary resources and activities are contingent upon the innovation characteristics and its subsequent stage of development/commercialisation (Aarikka-stenroos & Sandberg, 2012).

### 2.1.5 Innovation in service ecosystems

Another (potentially more comprehensive) way to define ecosystems in which innovation occurs is featured in service-dominant (S-D) logic. S-D logic promotes a service ecosystem perspective that connects technological and social aspects of markets and explains the integration of dynamic resources as service provision (Vargo et al., 2015). The idea of a service ecosystem is characterised by a network of interrelated actors who are connected through institutions and co-create value through resource/service exchange (Vargo et al., 2015). For instance, the actors within the agriculture ecosystem constitute primary producers, tech providers, the government, Māori, industry bodies, and consumers (MPI, 2020). The service ecosystem encapsulates collective order and regulation that drives cooperative

interaction and frames the social norms, rules and values as institutional arrangements that connect actors for innovation (Chandler et al., 2019; Edquist & Hommen, 1999; Vargo et al., 2015). Within a service ecosystem, there are three important considerations; 1) Technology is defined as a dynamic resource or knowledge which may be useful, 2) Markets are framed as solutions to institutionalisations and 3) Innovation is seen as the intentional combination of resources and practices that provide new solutions to problems faced in the present and future (Vargo et al., 2015). Thus, innovation can be extended beyond technological advances to encapsulate institutions (rules, values, norms and beliefs) that govern human action as central to value creation (Chandler et al., 2019; Vargo et al., 2015).

The service ecosystem perspective reveals a bidirectional, dynamic relationship between institutions and actors (Geels, 2004; Vargo et al., 2015). Central to this dynamic relationship is the idea of institutionalisation, which refers to the maintenance, disruption and change of institutional structure (Chandler et al., 2019; Vargo et al., 2015). Institutionalisation within a service ecosystem framework seeks to explain several phenomena: Firstly, innovation is the institutionalisation of new solutions and co-creation of value; secondly, institutionalisation is driven by complex interactions between the system's actors; lastly, institutionalisation encompasses the development and diffusion of both technology and markets (Vargo et al., 2015).

Institutionalisation is enacted through institutional work, which refers to the capacity for actors to participate in the maintenance and disruption of institutions (Chandler et al., 2019). Institutional work reflects practices that transform institutions and the ability of actors to repair and conceal conflicts that may arise (Vargo et al., 2015). Institutional work is also subject to actors' capabilities which are both context and system-specific (Vargo et al., 2015). As a result, the service ecosystem perspective highlights the underlying innovation processes in both technology and markets. Innovation is facilitated by institutional work and dynamic interactions between network actors and is viewed as the institutionalisation of new solutions (Vargo et al., 2015).

Within service ecosystems, the system is reliant upon service exchange. Each exchange of resource/service can influence the system and provide an institutional shift that serves as the basis for the next iteration of resource integration and value creation (Vargo et al., 2015). This explains how the system is continuously evolving as services are exchanged and actors integrate resources to adapt to and shape the institutional environment in which it exists.

Consequently, service ecosystems are made up of a diverse network of actors who are connected by institutions and service exchange (Chandler et al., 2019). This view then depicts institutional change as the process for both production and diffusion of innovations where a novel solution is generated and applied within and across social structures (Vargo et al., 2020).

In order to understand how innovation emerges within a service ecosystem, this thesis draws from Chandler et al. (2019) framework. The framework extends research on innovation by a focal actor (Porter, 1985; Teece, 1986) or a network of actors (Adner & Kapoor, 2010; Gawer & Cusumano, 2014). The framework connects service literature (Skålén et al., 2015; Vargo et al., 2015) with ecosystems (Adner & Kapoor, 2010), capabilities (Teece et al., 1997) and open innovation research (Enkel et al., 2009) to illustrate the dynamic process by which innovation emerges within a service ecosystem (Chandler et al., 2019). Within this framework, innovation is defined as an open-ended reconciliation of competing institutional paradigms (Chandler et al., 2019). It outlines the reconciliation pressures that create institutional dissonance and stability and how the service ecosystem is driven by dynamic interactions between its actors (Chandler et al., 2019).

Ecosystem plasticity is an inherent part of a service ecosystem and is driven by the perspectives of an ecosystem's actors (Chandler et al., 2019). Actors who are invested in the current institutional order are more likely to engage in maintenance activities. In contrast, less invested actors are more likely to pursue actions that disrupt the current order or create new institutions (Chandler et al., 2019). Plasticity reflects the degree to which a system can be moulded by actors and is necessary for the cohesive evolution of the ecosystem (Chandler et al., 2019). Plasticity is comprised of fluidity: the capacity of the system to be moulded, and stability: how the system retains its structure or retains changes induced by actors' moulding efforts (Chandler et al., 2019). Fluidity and stability are interdependent mechanisms that illustrate how actors react to new ideas and the underpinnings of these relationships that foster innovation (Chandler et al., 2019). Ecosystem plasticity leads to innovation through the emergence of solutions due to a system's fluidity and the convergence of ideas through institutional reconciliation (Chandler et al., 2019). Stability mechanisms then reinforce new institutional norms as actors participate in institutional work to home in on a new institutional order.

The emergence of ideas within an ecosystem results from institutional dissonance (behaviours embodied by actors that oppose institutional norms). Dissonance reflects high

fluidity within an ecosystem as actors see the current institutional order as no longer fit for purpose or have investments in alternative orders (Chandler et al., 2019). For instance, dissonance exists in the current labour institutions within the agriculture ecosystem, as many see them as no longer fit for purpose. Institutional dissonance is characterised by tensions and divergences (Chandler et al., 2019). Tensions arise when an actor has a low investment in the current institutional order. This reflects that the current institutional no longer serves the actor's interests, or the actor has investments in alternative institutional orders (Chandler et al., 2019). Divergences reflect the investments made by actors in competing institutional arrangements (Chandler et al., 2019). Institutional dissonance allows novel solutions to arise within an ecosystem; the ability of solutions to change the institutional order is dependent upon institutional stabilising efforts.

Stabilising activities facilitate the reconciliation of institutional dissonance and the emergence of a dominant institution (Chandler et al., 2019). The expected value of new solutions and their anticipated outcomes characterises the stabilising efforts that actors will engage in (Chandler et al., 2019). Service beneficiaries determine the expected value of innovation, reflecting the incentives for actors to engage in service activities and invest in the new order (Vargo et al., 2015). For instance, the expected value of agritech based innovations can be determined by primary producers, the government, consumers and other agritech providers. Where actors perceive the expected value of the innovation to be worthwhile of their investment, they will engage in institutional work to facilitate the prevailing institutional order and co-create value (Chandler et al., 2019). The reconciliation of institutional dissonance and stabilisation of new ideas attempts to position the ecosystem to serve the actors' interests best. Where institutional reconciliation does not result in an adequate solution, the innovation will not progress. However, actors will align with an idea and cumulatively come up with solutions to stabilise the ecosystem.

Within the Chandler et al. (2019) framework, the innovation process is characterised as continuous institutional reconciliation based on dynamic interactions between actors within and across institutions. Chandler et al. (2019) emphasise that the institutional reconciliation process is communicated through a metaspace that accounts for the time needed for actors to learn or change their beliefs (Chandler et al., 2019). The plasticity of the ecosystem can determine the capacity of the metaspace to transmit the effects of institutional reconciliation and consequently influences the innovation process. Plasticity influences innovation in four

ways (recursivity, temporality, complementarity, and continuity). Recursivity is critical for the emergence of the dominant design over multiple iterations (Teece, 1986). Plasticity influences the number and size of the feedback loops to achieve institutional reconciliation (Chandler et al., 2019). For an idea to be institutionalised, it must be reinforced or supported by complementarity in stabilising efforts governed by the perceived value of the solution and institutional work completed by other actors in the ecosystem. As service ecosystems are constantly changing, there is also a temporal element by which institutional reconciliation is achieved. The plasticity of the ecosystem determines the rate at which the system goes through dissonance and subsequent stabilisation to reach a new dominant order (Chandler et al., 2019). Reconciliation may never be fully completed due to the complexity and variability of different service ecosystems. Consequently, the tensions driving the innovation process can last indefinitely (Chandler et al., 2019).

## 2.2 Resilience

### 2.2.1 How is Resilience defined

As discussed above, innovation relies upon capabilities, value creation and a dynamic interaction between fluidity and stability. The agriculture ecosystem is inherently resilient and invested in stability (with limited space for change), which may to some degree explain the innovation problem within the ecosystem. In order to understand the interactions between innovation and resilience, this section reviews the resilience literature from both organisational and systemic perspectives.

Resilience has multiple definitions and functions within the literature. Resilience has been used across various disciplines, from engineering to biological ecosystems, and is framed differently across various levels of analysis. Consequently, conceptualisations of what constitutes resilient systems, organisations or individuals are fragmented across the literature and context-specific (Williams et al., 2017). The first definitions of resilience referenced the ability of ecological systems to resist disturbances (Therrien et al., 2017). On the system level, Boin (2010, p. 9) defines resilience as “the capacity of a social system to proactively adapt and recover from disturbances that are perceived within the system to fall outside the range of normal and expected disturbances”. On the organisational level, management literature seeks to understand the processes utilised by organisations that allow them to navigate environmental

uncertainty and resist adversity (Williams et al., 2017). Resilience is also a set of cognitive, behavioural and contextual properties that inform a firm's ability to understand and develop responses that reflect an understanding of its current and future situations (Williams et al., 2017). Resilience on the individual level is similar to that of the organisational level, whereby resilience has been used to explain how organisational members positively adjust in the face of disturbances (Williams et al., 2017). Other perspectives on resilience include; positive adjustment, absorbing disturbances (Walker et al., 2004), recovery and bouncing back from challenges (Weick et al., 2005), and navigating environmental uncertainty or "unknown unknowns" (Teece et al., 2016). In general, resilience describes the ability to foresee, react to and recover from disruptions, having minimal effects on the functioning on an individual, organisational or system level (Williams et al., 2017).

### 2.2.2 Outcome vs process of resilience

Like innovation, resilience can be viewed as a process and an outcome. Williams et al. (2017) highlight the process-outcome definitions of resilience as a key source of tension within the resilience literature. The literature views resilience as a capacity that develops over time. It also highlights a process of dynamic interactions between an organisation and its environment (Williams et al., 2017). On the other hand, the outcome element of resilience refers to avoiding disturbances, the state of return, positive adjustment, or emerging better than before (Linnenluecke, 2017; Williams et al., 2017).

Williams et al. (2017) argue that resilience is a process that captures the ability of an entity to be dynamic and relate to its environment in the face of disruption. Given that the resilience literature is largely context and event dependent (Walker et al., 2004), Williams et al. (2017, p.742) provides a holistic definition of resilience as "the process by which an actor (i.e., individual, organisation, or community) builds and uses its capability endowments to interact with the environment in a way that positively adjusts and maintains functioning prior to, during, and following adversity." This view not only accounts for the dynamic interactions that are a result of resilient entities, but includes the building of capabilities pre adversity, the adjustment and deployment of resources during a disruption and the post crisis response (Williams et al., 2017).

### 2.2.3 Capabilities for resilience

Inherent to organisational resilience are 'capabilities' that allow actors to display resilience (Williams et al., 2017). Capabilities for resilience focus on management and organisational competencies that help organisations integrate, build and reallocate resources in response to changing business environments (Linnenluecke, 2017; Teece et al., 2016). The dynamic capabilities framework introduced by Teece et al., (1997) can also be utilised in a resilience context as the knowledge, skills and abilities that allow organisations to respond to environmental uncertainty. Capabilities for resilience can also be defined as a set of resource endowments that facilitate positive adjustment in the face of adversity (Williams et al., 2017a). When addressing environmental uncertainty, managers are required to orchestrate the organisational response, thereby enabling positive adjustment (Gittell et al., 2006); for instance, redeploying financial resources, technical expertise and managing stakeholder interests (Teece et al., 2016). Hence the capabilities or resource endowments built over time and utilised in disruptive events are a core strategic issue for organisational resilience.

Resource endowments can be separated into five different categories: Financial Capability, Cognitive Capability, Behavioural Capability, Emotion-regulation and Relational Capability (Williams et al., 2017). **Financial Capability** endowments or 'financial slack' is a key capability that allows individuals or organisations to buffer themselves through their asset base (Teece et al., 2016; Williams et al., 2017). Whilst financial slack and material resources are integral to the operation of an organisation when cash flow may be constrained, other implicit endowments position actors better to maintain resilience in the face of disruption. **Cognitive** and **Behavioural Capability** endowments allow organisations to notice, interpret and delineate a path forward in the face of disruption (Teece et al., 2016; Williams et al., 2017). These implicit capabilities guide the combination and deployment of resources to allow the organisation to be adaptable in the face of new challenges. **Cognitive Capabilities** reflect the knowledge, vision, and values of key individuals within an organisation. Managerial sensemaking as an outcome of cognitive capabilities is imperative for understanding disruptions, reconfiguring activities, and envisaging future environments (Teece et al., 2016). On the other hand, **Behavioural Capabilities** refer to the behavioural repertoires embedded in the firm's structural aspects (values, culture, resources) (Teece et al., 2016). They extend beyond cognitive capabilities by linking the capacity of individual parts of the system with the organisational design as being integral for the collective ability to implement required changes

(Teece et al., 2016; Williams et al., 2017). **Emotion Regulation Capabilities** play a functional role in facilitating the ability of actors to cope with environmental disruption. This links mental hardiness with the way actors can make sense of the environment and produce positive outcomes (Williams et al., 2017). **Relational Capabilities** are another integral component of resilience from an organisational and systems perspective. Relational capabilities refer to the social interactions between actors that facilitate the exchange of resources (Teece, 2007; Williams et al., 2017). They also provide a context in which other capabilities are activated. Social networks also help facilitate trust between actors on multiple levels, which is needed for positive adjustment (Williams et al., 2017).

### 2.2.4 The process of resilience

The process of resilience can be segmented into three fundamental elements. It includes mechanisms prior to, during and after a disruption event (Williams et al., 2017). The first characteristic of resilience is preparedness which reflects the investment in endowments prior to adversity (Fehrer & Bove, 2022; Williams et al., 2017). In the case of agriculture, preparedness capabilities could entail biosecurity outbreak response plans or building redundancies into production processes. Nonetheless, the investment in endowments is proactive and discretionary. It provides organisations with the necessary resources and capabilities to avoid the threat or mitigate the disruptions that could be caused by potential adversity (Fehrer, 2021; Linnenluecke, 2017). Williams et al. (2017) describe preparedness as how organisations can anticipate and avoid or reduce the potential dangers of an adverse event. Organisations typically invest in preparedness by developing networks and coordination capabilities that allow the organisation to be adaptable and flexible during adversity, thereby avoiding or mitigating the effect of disturbances.

Investment in pre-adversity resilience mechanisms can be utilised for both anticipated risks and situations characterised by high environmental uncertainty. The dynamic capabilities framework suggests that mechanisms for managing anticipated risks and unforeseen uncertainties are significantly different (Teece et al., 2016). This impacts the strategic investments made for resilience. Boin & McConnell (2007) argue that where risks can be anticipated, strategic investment in capabilities for preparing and anticipating will serve organisations best. This will allow organisations to anticipate, prepare for, and avoid or reduce the effect of disruptions. In contrast, situations characterised by high environmental uncertainty reflect unanticipated dangers often where quick action is necessary (Teece et al., 2016). In this

case, investment in generic capabilities and resources allows decision-makers to make sense of the disruption and deploy resources to promote organisational agility, business model adaptability and minimise disturbances (Teece et al., 2016).

Teece et al. (2016) argue that whilst organisational slack and investment in capabilities can enable agility, investment comes at a cost that can promote rigidity. This is apparent in hierarchical organisations or those with investments in specialised capabilities that reflect path dependencies when the institutional structure changes. Survival and maintaining a competitive advantage is based on the firm's ability to dynamically relate to its environment (Teece et al., 2016).

The second characteristic of resilience investigates the response to a significant disturbance. Responsiveness refers to the ability to reduce the complexity during disruption and generate paths forward (Teece et al., 1997). An unanticipated disturbance represents an inflection point where environmental uncertainty is enhanced (Teece et al., 2016). Consequently, change is necessary for a firm to remain resilient Teece et al., 2016). Resilience from a responsiveness perspective looks to the immediate coping mechanisms and managerial sensemaking to generate a minimum response for survival (Williams et al., 2017) or engage in transformative activities that exploit the environmental change (Folke et al., 2010; Jiang et al., 2019; Kafetzopoulos, 2020). Key characteristics of responsiveness include: improvisation (Boin & McConnell, 2007), innovativeness Teece et al., 1997), spontaneous changeability (Boin & McConnell, 2007; Williams et al., 2017), and value creation (Nenonen & Storbacka, 2020).

Resilience during a crisis depends on an organisation's cognitive and behavioural responses to disruption, which are reinforced by the context and endowments on hand (Williams et al., 2017). Cognitive and behavioural responses represent the ability of decision-makers to reduce environmental complexity and formulate best action options for a path forward (Jiang et al., 2019; Lengnick-Hall & Beck, 2005). **Cognitive responses** reflect the actions of decision-makers to make sense of changes in the environment and make quick organisational changes in response to environmental uncertainty (Williams et al., 2017). The **Behavioural response** to disruption is perceived as an extension of a cognitive response as it focuses on the work done by actors to enact solutions and address environmental uncertainty (Williams et al., 2017). Behavioural responses also reflect the dynamic interaction between

actors and institutional structures at multiple levels. Thus, integrating cognitive and behavioural responses guides organisational responses to adversity (Williams et al., 2017).

Disruptions present the dilemma of staying the course or deviating from organisational routines to enable flexibility. Decision making and organisational structures that enable flexibility and agility can allow organisations to pivot in response to the changing environment (Teece et al., 2016; Williams et al., 2017). This contrasts with rigid decision making and organisational structures that can commit organisations to detrimental paths and compound disruption (Williams et al., 2017).

The last characteristic of resilience is adaptability. As actors prepare for and respond to adversity, they may gather new perspectives and restructure resource endowments for subsequent adversity (Fehrer & Bove, 2022). There is a dynamic interaction between an organisation and its environment whereby exposure to adversity and the learning that results can foster improved responses to subsequent disruptions (Linnenluecke, 2017). Interpretations and responses evolve based on the nature and time scale of disruptions and the previous behaviours of actors (Williams et al., 2017). Resilience feedback loops allow actors to develop capabilities and provide more situation-specific responses as they can make better sense of situations and redeploy resources accordingly (Boin & McConnell, 2007).

Organisational learning and evolving resilience endowments can enhance the survival and transformative actions taken by a firm (Boin & McConnell, 2007; Williams et al., 2017). Resilience mechanisms can also result in organisational rigidity through the failure to learn, inability to be agile or resistance to environmental change. Consequently, a key strategic importance is enlisted in selecting investments made for resilience.

### 2.2.5 A systems perspective of resilience

Contemporary organisations are embedded in a network of interrelated stakeholders, whereby the structural properties and interactions inherent to the system are an essential factor for resilience (Gilly et al., 2014). Resilience literature highlights the dynamic interactions between actors and a continually changing environment. The bidirectional feedback effects mean actors must adapt or risk succumbing to environmental pressures (Kabadayi et al., 2020). This is especially important in the agriculture ecosystem as it underpins the food system. The systems perspective of resilience emphasises resilience as an emergent, macroscopic property

dependent on the interaction between micro-level elements (individuals, organisations and institutions) (Finsterwalder & Kuppelwieser, 2020; Kabadayi et al., 2020; Normandin & Therrien, 2016).

Normandin & Therrien (2016) highlight a fundamental tension within the resilience literature, whereby resilience can be a return to the status quo; at the same time, adaptability and transformation are also key characteristics of resilience. Normandin & Therrien (2016) propose a solution to this dilemma by delineating resilience mechanisms into stabilising and transforming activities that can be used to shape ecosystems. Nenonen & Storbacka (2020) suggest that resilience and flexibility are less important. Instead, shaping oriented strategies are needed by actors to shift the system towards a preferred direction. Fehrer & Bove (2022) reinforce this point and claim there is still a need to understand how positive functioning relates to bouncing back from disruption and shaping the system, and bouncing forward towards a new order. The framework proposed by Normandin & Therrien (2016) will be used to explicate the duality and complementarity between resilience mechanisms that allow ecosystems to be shaped and remain resilient to disruption.

Normandin & Therrien (2016) suggest that resilience should be explained in accordance with negentropy (stability) and entropy (change). Using this framework, resilience emerges from the interplay between favourable order and disorder mechanisms (Normandin & Therrien, 2016). Resilience mechanisms that promote order reduce environmental uncertainty and activities that stabilise the system and promote survival (In agriculture, this could relate to risk mitigation strategies) (Normandin & Therrien, 2016). The key outcomes are continuity, consistency and reliability (Normandin & Therrien, 2016). Resilience mechanisms that promote disorder look to deviate from the current structure by integrating new ideas, diversifying practices and integrating redundancies (In agriculture, this could relate to introducing new technologies) (Normandin & Therrien, 2016). The key outcomes are adaptability, agility and innovation. Nenonen & Storbacka (2020) and Fehrer et al. (2022) point out that crisis events induce a high degree of malleability within ecosystems and present a unique opportunity to shape them. Resilience subsequently emerges from the dynamic and complementary nature of favourable order, promoting survival and regulation, and favourable disorder mechanisms promoting adaptability and innovation (Normandin & Therrien, 2016).

There is a need for both types of resilience mechanisms in order for systems to remain flexible and innovative (Fehrer et al., 2022). Overusing either tactic will inevitably result in

rigidity or risk destabilising the ecosystem into ensued chaos (Fehrer et al., 2022). Vulnerability from unfavourable order, i.e., organisational rigidity or path lock-in, limits the capacity for innovation and the ability to transform (Gilly et al., 2014). On the other hand, vulnerability from unfavourable disorder arises as environmental uncertainty is prolonged, which can impact actor performance once the crisis event has passed (Normandin & Therrien, 2016). Consequently, a balance between order and disorder mechanisms is required to promote system resilience. A system can easily progress from resilience to vulnerability (Fehrer et al., 2022).

### 2.2.6 The dark side of resilience

There is also evidence to suggest that resilience mechanisms can hinder innovation. This 'dark' side of resilience is less discussed in the literature but can occur through several mechanisms (Williams et al., 2017). Firstly, more resilient actors may lack the sensemaking capabilities and the learning opportunities that arise from failure and adversity. This means decision-makers are less likely to have the cognitive insight to successfully pivot or engage in transformative activities in the face of disruption (Williams et al., 2017). Secondly, resilience facilitates persistence in activities despite disruptions and hardship (Williams et al., 2017). This could result in the commitment to a losing course of action, especially when the system is shifting to a new order. Lastly, investment in endowments, such as resilience and agility, can present an opportunity cost for other activities such as innovation (Teece et al., 2016). The investment influences preparation, decision-making, and resource allocation during normal functioning and adversity. Resilience mainly confers a positive response in the face of adversity, although it may be detrimental to a system/actors in certain contexts.

## 2.3 Summary of the literature review- Toward an integrated framework

Examination of the innovation and resilience literature in relation to the research questions has outlined the current knowledge surrounding these two topics. From the examination of the literature, it is evident that there is a complex interaction between innovation and resilience that is still not well understood.

From the analysis of the current literature, organisational perspectives contain more distinct boundaries between innovation and resilience. Innovation is considered an essential activity in organisational differentiation, evolution and value creation (Chandler et al., 2019;

Heinonen & Strandvik, 2021). Innovation is often viewed as a discretionary 'strategic' activity for organisations that want to maximise value creation and growth (Heinonen & Strandvik, 2021). Innovation also allows organisations to respond to and drive change in their environment.

In contrast, the resilience literature focuses on the ability of organisations to navigate disruption or environmental uncertainty (Williams et al., 2017). The literature focuses on how organisations can bounce back or mitigate disruption rather than use disruption to drive transformation (Fehrer et al., 2022). The literature also highlights a dark side of resilience that introduces tensions with innovation (Williams et al., 2017). Resilience can promote rigidity, path dependencies and reduce organisational learning, which can be detrimental to innovation. Table 1 at the end of this section summarises the organisational perspectives of innovation and resilience, and the capabilities inherent to each concept.

Innovation is also an important consideration in resilient systems. Sabahi & Parast (2019) argue that innovation can enhance the capabilities of knowledge sharing, agility and flexibility, capabilities that are often associated with resilience. Furthermore, there is a direct link between innovative environments and resilience to disruptions (Sabahi & Parast, 2019). The ecosystemic perspective highlights that the ecosystem is reliant upon complementary and interdependent interactions between order and disorder (Normandin & Therrien, 2016). There is a need for both these mechanisms in order for the ecosystem to remain innovative, flexible and resilient.

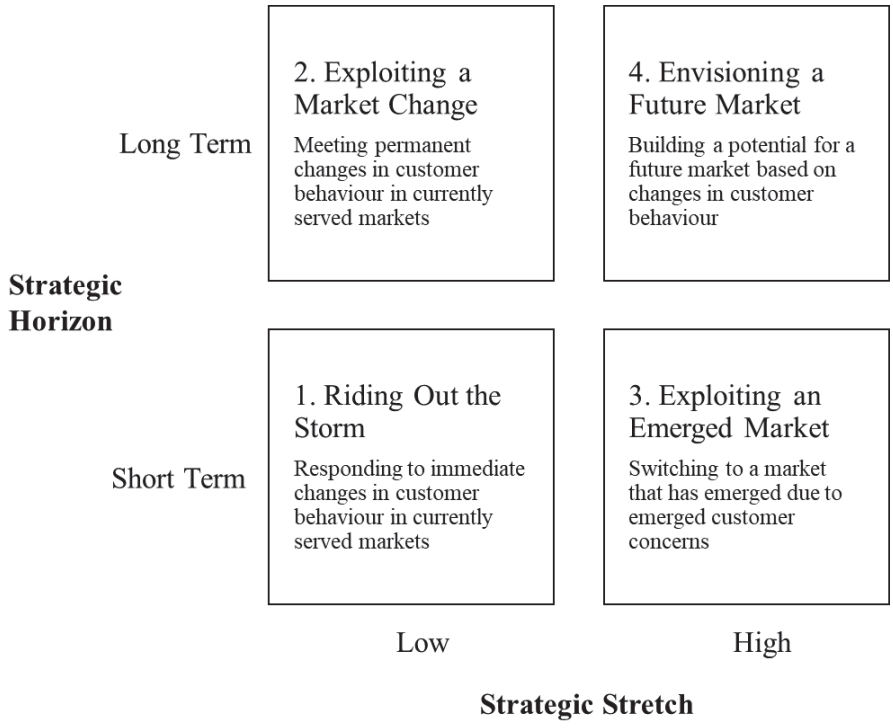
Heinonen & Strandvik (2021) attempt to explain the interaction between innovation and resilience in a crisis context. The extreme uncertainty and unparalleled disruptions caused by the COVID-19 pandemic have forced decision-makers to determine how they deploy capabilities to remain functioning. Consequently, the pandemic has shifted the focus on innovation from a discretionary activity to a necessary activity to ensure survival Heinonen & Strandvik (2021). As a result, Heinonen & Strandvik (2021) characterise imposed service innovation as a phenomenon that links innovation with resilience.

Imposed innovations resulting from the pandemic can be characterised on a scale of minor adjustments in offerings to profound changes depending on the nature of the disruption and the firm's strategic objectives. For example, the hospitality and tourism sector has faced profound disruption whilst professional services have faced less of a disruption.

Gopalakrishnan & Kovoor-Misra (2021) found that innovations can be 1) reactive to mitigate the imposed pressures of an organisational crisis or 2) proactive innovations that allow the organisation to capitalise on environmental disruption and drive value creation. Nenonen & Storbacka (2020) suggest that crisis events challenge institutional logics and present opportunities for actors to improve the ecosystem and nudge it in a preferred direction. Heinonen & Strandvik (2021) characterised four different archetypes of imposed innovation depending on the innovations' strategic stretch and strategic horizon. This is outlined in Figure 1 below.

**Figure 1.**

*Archetypes of innovation. Adapted from Heinonen & Strandvik (2021)*




As outlined in Figure 1, imposed innovations can be both characterised by the strategic stretch and strategic horizon. Those activities with a low strategic stretch relate to innovations that allow the organisation to ride out the storm or exploit market changes. According to Fehrer & Bove (2022), these kinds of activities act as negative feedback loops to stabilise service ecosystems and allow them to be resilient. On the other hand, activities that require a high strategic stretch use the organisation's resources and capabilities to shift value creation processes to create a novel service or envisage future offerings. These activities act as positive

feedback loops that aim to shape the institutional structure toward a better system (Fehrer & Bove, 2022).

The researcher argues that the pandemic has introduced widespread institutional dissonance into the ecosystem. The resilience-innovation framework can be used to explain how institutional reconciliation is achieved as actors try to re-establish the equilibrium disrupted by the crisis (Nenonen & Storbacka, 2020). Viewing innovation and resilience through a lens of disruption and environmental uncertainty introduces a strategic focus to the activities that actors engage in. This helps to explain actor interactions and activities in the context of capabilities, strategy and time horizons (Heinonen & Strandvik, 2021). Furthermore, an impetus is placed on the relevance of innovations and activities in the innovation ecosystem rather than focusing on organisational viability or competitive advantage alone (Heinonen & Strandvik, 2021).

This study will utilise the NZ agriculture ecosystem as the empirical setting to understand the complex interactions between innovation and resilience in service ecosystems. The literature review has revealed some evident tensions and reinforcements within the innovation and resilience literature. The literature suggests that an overreliance on stabilising activities could be responsible for the innovation problem within the agriculture ecosystem (Fehrer & Bove, 2022). Unfavourable order recognises the rigidity of the ecosystem and the limited capacity for innovation and transformation (Fehrer & Bove, 2022). Similarly, the inherent focus on bouncing back from disruption can limit the ability of organisations to engage in transformative activities (Fehrer et al., 2022). However, from the literature review, it is also clear that the interactions between innovation and resilience are not well understood. Further, there is currently a lack of empirical evidence that explains how organisations can engage in long term innovation during a crisis, whilst still remaining resilient (Fehrer & Bove, 2022; Teece et al., 2016). Consequently, the empirical setting will be used to explore these gaps further.

**Table 1.**

*Summary of capabilities for innovation and resilience*

| | Innovation | Resilience |
|---|---|---|
| **Purpose of capabilities** | Innovation capabilities explore the transformational nature of an organisation's activities and resources. These arise from the exploitation of a firm's internal capabilities as well as the exploration of new capabilities (Bouncken & Kraus, 2013; Crossan & Apaydin, 2010).<br><br>Innovation capabilities reflect the development and deployment of resources that allows an organisation to create value and capture economic rents (Teece et al., 1997; Teece, 2007).<br><br>Capabilities allow organisations to respond to changing opportunity structures in a dynamic environment. They provide a context for the ability of the organisation to develop new solutions, drive change and orchestrate actors to suit their strategic objectives (Teece, 2007). | Resilience capabilities are the knowledge, skills and routines that allow actors to plan for and respond to environmental uncertainty and disruption (Teece et al., 2016; Williams et al., 2017).<br><br>Capabilities for resilience focus on management and organisational competencies that help organisations integrate, build and reallocate resources in response to changing business environments (Linnenluecke, 2017; Teece et al., 2016). |
| **Types of Capabilities** | **Dynamic Capabilities** are concerned with the transformational nature of resources that the firm can access through horizontal and vertical mechanisms. They also allow firms to respond to and drive market changes (Nenonen et al., 2019; Teece & Teece, 2021).<br><br>**Cognitive capabilities** reflect the ability of decision-makers to sense and shape new opportunities. This allows managers to select the strategic objectives and integrate and deploy resources that enable the organisation to respond to and drive change (Pisano & Teece, 2007; Teece, 2007).<br><br>**Behavioural capabilities** reflect the organisational processes and knowledge sharing structures that can create new opportunities. How knowledge is integrated within an organisation is critical to innovation performance (Teece, 2007). | **Dynamic capabilities** are generalised capabilities that are strategically built over time and deployed in reaction to disturbances. They provide a context that allows an organisation to respond to market changes and environmental uncertainty (Teece et al., 2016; Williams et al., 2017).<br><br>**Cognitive capabilities** reflect the knowledge, vision, and values of key individuals within an organisation. They manifest as the firm's strategic intentions and allow managers to build other capabilities and notice, interpret, and respond to disruption (Williams et al., 2017).<br><br>**Behavioural capabilities** combine individual components with organisational design. They reflect the values, culture and resources of the firm and the collective ability to respond to environmental changes (Williams et al., 2017) |

| | | |
|---|---|---|
| **Ways Capabilities are deployed** | **Technological Capabilities** allow organisations to overcome innovation challenges that may constrain the ability of the innovation to create value for the market. Technological capabilities are often supplemented with scientific knowledge, which helps overcome challenges and opens up new opportunities (Adner & Kapoor, 2010).<br><br>**Marketing capabilities** allow the organisation to produce innovations that create customer value and address market needs. There are two main types of marketing capability - **market orientation** which allows the organisation to respond to market needs, and **market-shaping** capabilities, enabling the organisation to create new opportunities (Nenonen et al., 2019).<br><br>**Relational capabilities** allow firms to operate within cooperative networks that provide resources to facilitate innovation development, diffusion, and use. Innovation networks allow organisations to access resources, provide validation and access complementary technologies that enhance value creation (Aarikka-stenroos & Lehtimäki, 2014). | **Financial capabilities** provide organisations with the financial slack to withstand disruption. This allows an organisation to buffer itself through their asset base (Teece et al., 2016; Williams et al., 2017).<br><br>**Emotion regulation capabilities** reflect the mental hardiness of actors and the ability of actors to cope with environmental uncertainty. This links to how actors can make sense of the environment and produce positive outcomes/minimise disruption (Williams et al., 2017).<br><br>**Relational capabilities** reflect the social networks that facilitate trust and the exchange of resources between actors. They also provide a context in which other capabilities can be activated as organisations draw on external resources and capabilities to facilitate positive adjustment. (Williams et al., 2017). |
| | Capabilities allow organisations to sense and respond to innovation opportunities. When new opportunities are sensed, organisations will respond through investment in development and commercialisation activities (Teece, 2007).<br><br>In the development phase, capabilities allow organisations to unitise internal and external resources to create new technologies/knowledge. Development networks can provide access to resources and capabilities that facilitate the development of the focal innovation and complementary technologies. The value created by these new developments stems from the successful combination of resources and complementary technologies (Aarikka-stenroos & Sandberg, 2012).<br><br>Capabilities for commercialisation reflect the ability of an organisation to successfully combine resources that allows the successful introduction of the innovation to market. Orchestrating networks can validate the innovation and provide complementary technologies, enhancing value creation (Aarikka-stenroos & Sandberg, 2012). | Preparedness reflects the proactive and strategic investment in capabilities that allow organisations to prepare and respond to anticipated and unanticipated disruptions (Fehrer & Bove 2022; Linnenluecke, 2017; Teece et al., 2016)<br><br>Responsiveness refers to the immediate coping mechanisms and managerial sensemaking to generate a minimum response for survival or engage in transformative activities that exploit the environmental change (Folke et al., 2010; Jiang et al., 2019; Kafetzopoulos, 2020; Williams et al., 2017)<br><br>As actors prepare for and respond to disruptions, they may gather new perspectives that facilitate capabilities development or refinement. Resilience feedback loops allow actors to modify their behaviours for subsequent adversity (Williams et al., 2017). |

# Chapter 3: Methodology

This chapter will outline how this research was conducted. It will describe the research objectives, data collection and analysis methods and highlight the limitations of the study design.

## 3.1 The research objective

This thesis aims to understand the interactions between innovation and resilience using the empirical context of the agriculture ecosystem. The literature review shows that some inherent tensions between innovation and resilience may explain the ongoing innovation problem in the agriculture ecosystem. However, the literature review also highlights that the interactions between innovation and resilience are not well understood, highlighting a need to explore these interactions further. The theoretical analysis has highlighted a lack of understanding around organisations remaining resilient during a disruption whilst also trying to be innovative. Another question that presents itself is how resilience mechanisms and short-term workarounds impact long term strategic innovation. There is a need to identify how organisations not only bounce back during crisis events but place a strategic lens on the response to see how organisations can engage in activities that envision future environments.

In light of the problem this thesis seeks to address and the lack of literature to wholly understand the problem, this research paper aims to answer the following question:

*What are the tensions between resilience and innovation in service ecosystems?*

This research question has been broken down into three sub-questions to address gaps identified in the literature. This also allows the researcher to understand better the interaction between innovation and resilience in service ecosystems.

1) *How do innovation and resilience capabilities in the agriculture industry reinforce each other?*
2) *How do resilience and innovation capabilities balance themselves out/hinder each other?*
3) *How does an ecosystemic perspective provide enabling and disabling structures that support the reconciliation of innovation and resilience capabilities?*

## 3.2 Research design

This research project will follow an inductive approach. Inductive reasoning allows the researcher to develop new concepts and ideas and follows a logical process of developing first-order codes, second-order themes, and third-order dimensions (Gioia et al., 2013). The qualitative rigour imbued by an inductive analysis allows the researcher to surface new concepts and theories through data analysis (Gioia et al., 2013).

In line with the problem this thesis seeks to understand, the researcher adopted a case study approach (Yin, 2014). A case study analysis allowed the researcher to understand how organisations within the agriculture ecosystem have operated during the COVID-19 pandemic and investigate the capabilities and resources utilised in their actions (Yin, 2014). Yin (2014) explains that case studies are relevant when the research questions require an in-depth exploration of complex phenomena and social processes. The researcher adopted a comparative case study design and employed horizontal and vertical analysis techniques to identify similarities and differences between organisations in their activities for innovation and resilience (Bartlett & Vavrus, 2016). The research also seeks to understand the dynamic relationship between the organisation and the ecosystems in which it exists. Given the complexity of the agriculture ecosystem, the researcher deemed an embedded case study analysis was needed to understand the interactions between innovation and resilience. Furthermore, the embedded case study design promotes a relativistic setting to explore the context in which the research is embedded.

Data collection within each case study was achieved through exploratory semi-structured interviews. The main topics for the interview were outlined in an interview schedule (outlined in the appendix section of this thesis) prior to the commencement of the interviews. As the interview process progressed, the interview schedule was updated to include new ideas and themes that arose in preceding interviews (Timmermans & Tavory, 2012). Following the data collection techniques of inductive reasoning, new theory has been allowed to emerge as findings have been coded and categorised in the early stages of data collection. This has helped refine the data collection process as interviews progressed.

## 3.3 Sampling for comparative case studies

### 3.3.1 Selection of the research setting

This study aims to investigate the similarities and differences between innovation and resilience within service ecosystems. The agriculture setting is well suited to investigate this issue due to its current innovation problem and the high levels of resilience displayed within the ecosystem. The COVID-19 pandemic presents an opportunity to understand further the interaction between innovation and resilience within the empirical setting. The pandemic has introduced widespread disruption, and the ecosystem has been nationally recognised for its resilience. In addition to this, many innovation opportunities have been outlined for the ecosystem that could help it bounce forward (MPI, 2020). One of the challenges that the researcher would like to address is how activities in the agriculture ecosystem can be structured with strategic innovation in mind rather than activities that confer resilience.

Agriculture is a primary production industry and is pivotal to food security in NZ, and it is also a significant contributor to export revenue for the NZ economy (MPI, 2020). Therefore, the resilience of the agriculture industry is a matter of national importance. COVID-19 and its associated restrictions have had major impacts on the global and local environment. Many organisations have had to continue operating whilst navigating new operating conditions, disrupted supply chains and labour shortages–which were compounded by border restrictions (KPMG, 2020). As a result, farmers, growers, and other business have been praised for their resilience for feeding NZ and the rest of the world (Hort NZ, 2020).

Transformational opportunities have also been identified to facilitate the economic recovery for NZ in line with the MPI build for a better world initiative (MPI, 2020). The primary sectors have the potential to extract greater value across the value chain by being innovative and responding to market needs (MPI, 2020). However, there is tension in the agriculture sector which is operating under significant pressure. Addressing short term problems has made it challenging for management teams to be able to focus on long term opportunities and aspirations (KPMG, 2021).

The ability of agriculture organisations to capitalise on opportunities and drive change is determinant on the ability to understand what tensions may exist between innovation and

resilience, and subsequently, how to overcome them. The cases selected were reflective of 2 primary innovator groups within the ecosystem– Agritech provider organisations and Agriculture producer organisations. In the context of these organisations, the innovation and resilience drivers and activities are somewhat different. Therefore, contextual elements for each case type need to be taken into account.

### 3.3.2 Case Selection

This research paper aims to draw upon tensions between capabilities used for resilience and those used for innovation and value creation. The literature on systemic innovation and resilience states that these concepts can be evaluated on multiple levels (micro, meso and macro). Innovation and resilience will be investigated mainly on the organisational level, as this can provide more insight into activities engaged in for both innovation and resilience. This comparative case analysis intends to compare the activities conducted by producer organisations with those conducted by agritech organisations. These cases reflect different positions and influences on the agriculture value chain. They also engage in different activities for innovation and resilience. Furthermore, an analysis of the broader ecosystem helps identify the overarching institutional structure and provides a contextual element for the operational environment of these organisations. The structure of the agritech ecosystem is outlined in Figure 2 below

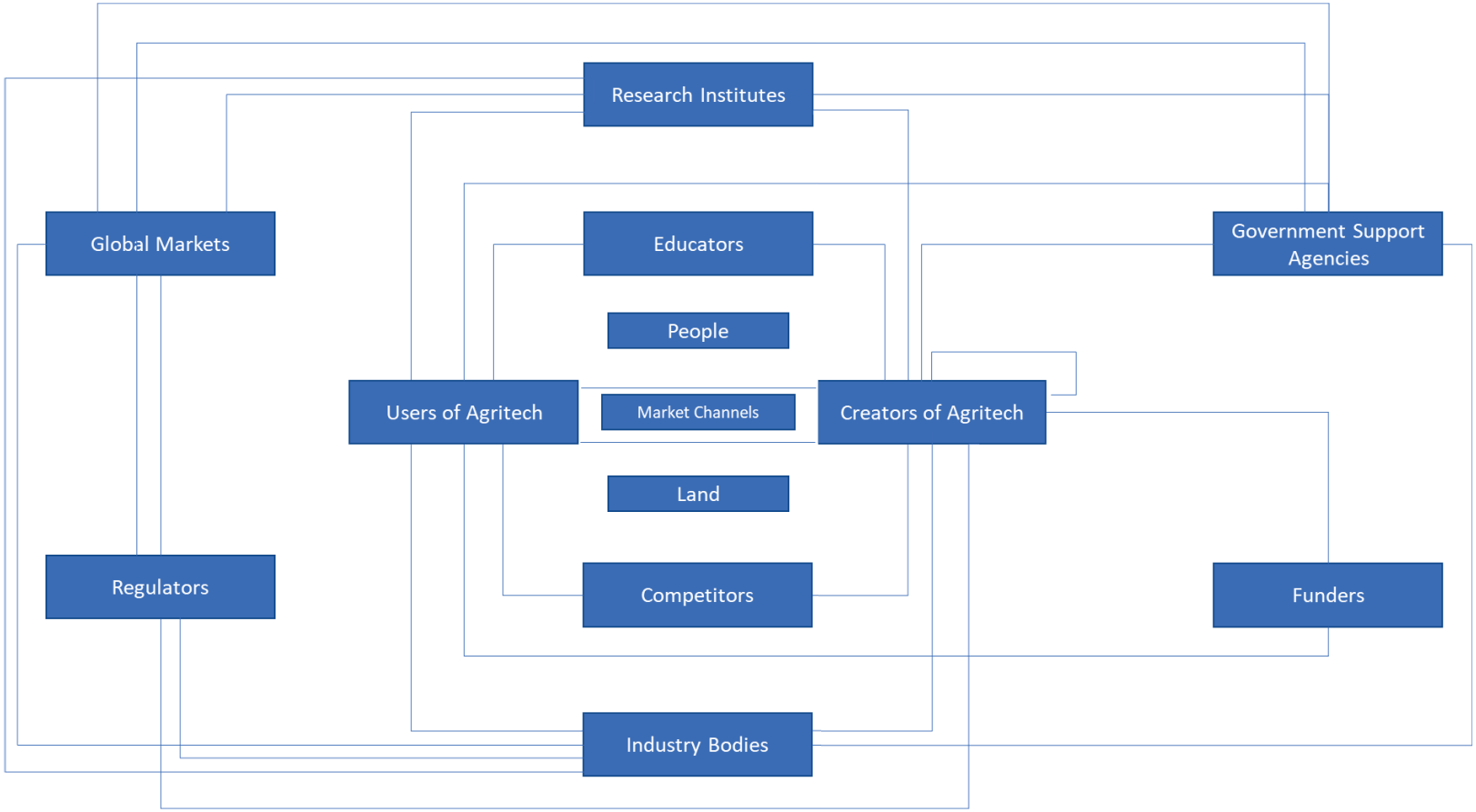
The cases are to be set out as follows:

Case Category 1: Agritech Provider Organisations. Agritech organisations were interviewed that provide an offering targeted towards several main industries; wine and pip fruit (apples and pears). Agritech organisations are typically providers of solutions and engage in innovative activities related to providing novel offerings for agriculture producers.

Case Category 2: Agriculture Producer Organisations. The main activities of these organisations are the production of horticulture based goods. They are typically adopters of technology and innovate their product offering/processes using agritech based solutions. These organisations are also integral to NZ food production resilience. The main producer industries were in line with the provider organisations; Wine and Pip fruit.

**Figure 2.**

*Structure of the agritech ecosystem. Adapted from MBIE (2020)*



## 3.4 Data Collection

Fourteen participants were interviewed who represented a broad cross-section of the agriculture ecosystem. The data gathered from these interviews was triangulated against secondary data sources.

### 3.4.1 Interviews

The primary data collection method in this thesis was semi-structured exploratory interviews. These were conducted with key members in organisations that spanned the agriculture ecosystem. The types of participants recruited and their role in the study can be seen in Table 2 below.

**Table 2**.

*Interview participants with their respective contributions to the study*.

| Participant Group | Organisation | Role in Study | Pseudonym |
|---|---|---|---|
| Agritech Provider | Agritech startup: No product in market | This interview partner was the founder of a start-up that was formed out of academic research. They were trying to shape the market to adopt their innovation. They provided insight into the capabilities used by tech startups to remain innovative and resilient during the COVID-19 crisis. | Agritech Startup 1 |
| | Agritech Startup: product in market | This interview partner was the founder of an agritech startup. This organisation already had products in the market prior to the COVID-19 pandemic. They were also trying to progress the institutional environment towards automation-based technologies. In addition to this, they had extensive experience within the agriculture ecosystem, so they could comment on the ecosystem's structure. | Agritech Startup 2 |
| | Agritech Startup product in market | The interview partner was the CEO of their organisation. This organisation already had a product in the market prior to the COVID-19 pandemic. During the crisis, they innovated with their product offering to make it more suited to their customers, which was essential for their resilience. They spoke for the decisions that allowed them to maintain their innovative activities. They also have knowledge about the wine ecosystem. | Agritech Startup 3 |

| | | | |
|---|---|---|---|
| | Agritech incumbent | The interview partner was an innovation manager within their organisation. This organisation was a global facing organisation and provided information on how addressing global needs can drive innovation. They were able to talk to the capabilities that enabled them to address their market despite COVID-19 disruptions. They spoke about the ongoing effects of COVID-19 and how they have changed over time. | Agritech Incumbent |
| Agriculture Producer | Large wine organisation | The interview partner was an innovation executive within their organisation. The organisation saw itself as being innovative and a first mover within the ecosystem. As a large organisation, they gave information about the different innovation drivers for producer organisations. They also explained the innovation relationships that exist between producers and providers. | Large agriculture 1 |
| | Small wine organisation | The interview partner was the operations manager within their organisation. This organisation was a small producer. They gave information on the diversity of the wine industry and illustrated how even within the industry, the capabilities and drivers are different. Furthermore, this producer gave a perspective of the inconsistent impacts of COVID-19 across the industry. | Small agriculture |
| | Large Seed producer | The interview partner was a corporate development manager for a large agriculture organisation. The insight provided by this interview partner was the biological focus of many producers. Furthermore, they emphasised the timeline consideration with biological based innovations. | Large agriculture 2 |
| Ecosystem Overview | Agribusiness advisory firm | This interview partner occupied a senior level in an agribusiness advisory firm. They were able to talk to the role of industry structure on the patterns of innovation and resilience within the agriculture industry. They were also able to comment on the inconsistent impacts of the COVID-19 pandemic across the industry. As they also have global insights, they were able to comment on global innovation drivers and trends that have emerged because of the pandemic. | Agribusiness advisor 1 |
| | Agribusiness advisory firm | This interview partner held a more junior role within the agribusiness advisory firm. This partner was more involved with their clients, so they could speak to organisations' direct effects and responses to COVID-19. They also provided expertise on the dynamics of exchange within the agribusiness ecosystem. | Agribusiness advisor 2 |
| | Industry Body | This interview partner was involved in an industry body for the pip fruit industry. They were able to comment on the innovation drivers of the pip fruit | Industry body 1 |

| | | | |
|---|---|---|---|
| | | industry. They were also able to comment on the role of industry bodies within the ecosystem. | |
| | Industry Body | This interview partner was from an industry body that served agritech providers. They were able to comment on innovation within the agritech provider space. They also give a good overview of the impacts of COVID-19 on the ecosystem. They were also able to comment on the role of industry bodies within the ecosystem. | Industry body 2 |
| | Research Organisation | This research organisation was a CRI and provided information on how science commercialisation can create value for the industry. This organisation is also closely involved with different organisations within the agriculture ecosystem. They were able to talk to how they have seen organisations respond to the COVD-19 pandemic. | Research institute 1 |
| | Research Organisation | This research organisation was focused on wine research. Their long service in the wine industry allowed them to comment on the wine ecosystem dynamics. They also were able to comment on how wine organisations have been affected by the pandemic. | Research institute 2 |
| | Funder | This interview partner was the CEO of a funding organisation. They were able to comment on the role funding has within the ecosystem and how funding enables the capacity for innovation. They were also able to talk about individual entrepreneurial capabilities and how they determine the success of an organisation. In addition to this, the funder explained how they contribute to building capabilities in startups and connecting the ecosystem. | Funder |

### 3.4.2 Interview Guideline

The interview participants all had different roles and areas of expertise across the agriculture ecosystem. Because of this, the primary interview guideline was modified in accordance with the role the interview partner played in the agriculture ecosystem. The process of interviewing participants was iterative in the sense that findings and exciting points from previous interviews were used to shape the questions and points explored in subsequent interviews. In addition to this, the interview process was flexible, with the interview schedule acting as a guideline and allowing participants to discuss topics of particular importance to them. This allowed the researcher to gain insights that would not have otherwise been gained by adhering strictly to an interview schedule.

This study recruited 14 participants to answer the research question. Due to the COVID-19 pandemic and location differences between the researcher and participants, video conferencing software (Microsoft Teams) was used to conduct interviews. Interviews were recorded and transcribed simultaneously via the recording and transcription functions on the Microsoft teams platform. Interviews took between 50 and 70 minutes. This gave the researcher approximately 14 hours worth of interview data. This sample size was viewed as being sufficient to answer the research questions. The raw transcript outputs were then reviewed in conjunction with the interview recordings to ensure the accuracy of the transcripts. Completed transcripts were then sent back to the interview participants for review. This was to ensure the information's accuracy and give the interview partner the option to omit any commercially sensitive or identifying information. Following the approval of transcripts or non-communication from the participant exceeding 14 days (whichever was first to occur), the transcript was deemed to be finalised and was entered into the Nvivo qualitative analysis software to be analysed.

### 3.4.3 Secondary Data

To support the primary dataset, the study also collated secondary data sources. These data sources were used to increase the depth of knowledge that the researcher got from primary interviews. They also increase the validity of the findings by triangulating findings from multiple sources. The secondary data sources were retrieved from industry reports, government papers and policy documents. In total 486 pages of secondary materials were used. The breakdown of the secondary data sources utilised in this study is outlined in Table 3 below.

**Table 3.**

*Secondary Data Sources.*

| Secondary Data | Title | Overview | Author | Year | Length |
|---|---|---|---|---|---|
| | New Zealand Agritech Insights Report | Provides information on NZ's agritech sector. | Technology Investment Network | 2020 | 23 Pages |
| | Agritech Industry Transformation Plan | Policy document aimed at boosting the agritech ecosystem. Outlines key opportunities and issues. | MBIE | 2020 | 54 Pages |

| | | | | | |
|---|---|---|---|---|---|
| | Agribusiness Agenda 2020 | Insight piece that provides an overview of the Agri ecosystem. Highlights key opportunities and issues in the sector. | KPMG | 2020 | 38 Pages |
| | Agribusiness Agenda 2021 | Insight piece that provides an overview of the Agri ecosystem. Highlights key opportunities and issues in the sector. | KPMG | 2021 | 92 pages |
| | Horticulture Post Recovery Strategy | An industry body document outlining a strategy for the horticulture sector post COVID. | Horticulture NZ | 2020 | 23 Pages |
| | Fit for a better world | MPI strategy document that provides a roadmap and outlines the opportunities that the Government believes will boost productivity, sustainability, and inclusiveness of the primary sector. | MPI | 2020 | 24 Pages |
| | A Refreshed Industry Strategy in Response to COVID-19 | Policy document that outlies an industry strategy as part of the government's economic response to COVID-19. | MBIE | 2020 | 28 pages |
| | Aotearoa Agritech Unleashed | Provides analysis of the impact that agritech has on the NZ economy and provides opportunities for future growth and development. | Agritech NZ | 2020 | 76 Pages |
| | NZ Grower – September 2020 | Monthly industry publication that provides an overview of the state of the industry. | Horticulture NZ | 2020 | 33 Pages |
| | Frontier firms: Four industry case studies | Productivity related research document focusing on innovation across 4 case studies. Horticulture is the case study of interest in this document | New Zealand Productivity Commission | 2021 | 66 Pages |
| | Could do better Migration and New Zealand's frontier firms NZIER report to the New Zealand Productivity Commission | Report commenting on the utilisation of labour in the NZ economy. Talks comprehensively about the labour issues prominent in the NZ horticulture industry | New Zealand Institute of economic research | 2020 | 29 Pages |
| | **Total** | | | | **486 Pages** |

**Table 4.**

*Overview of Data Sources*

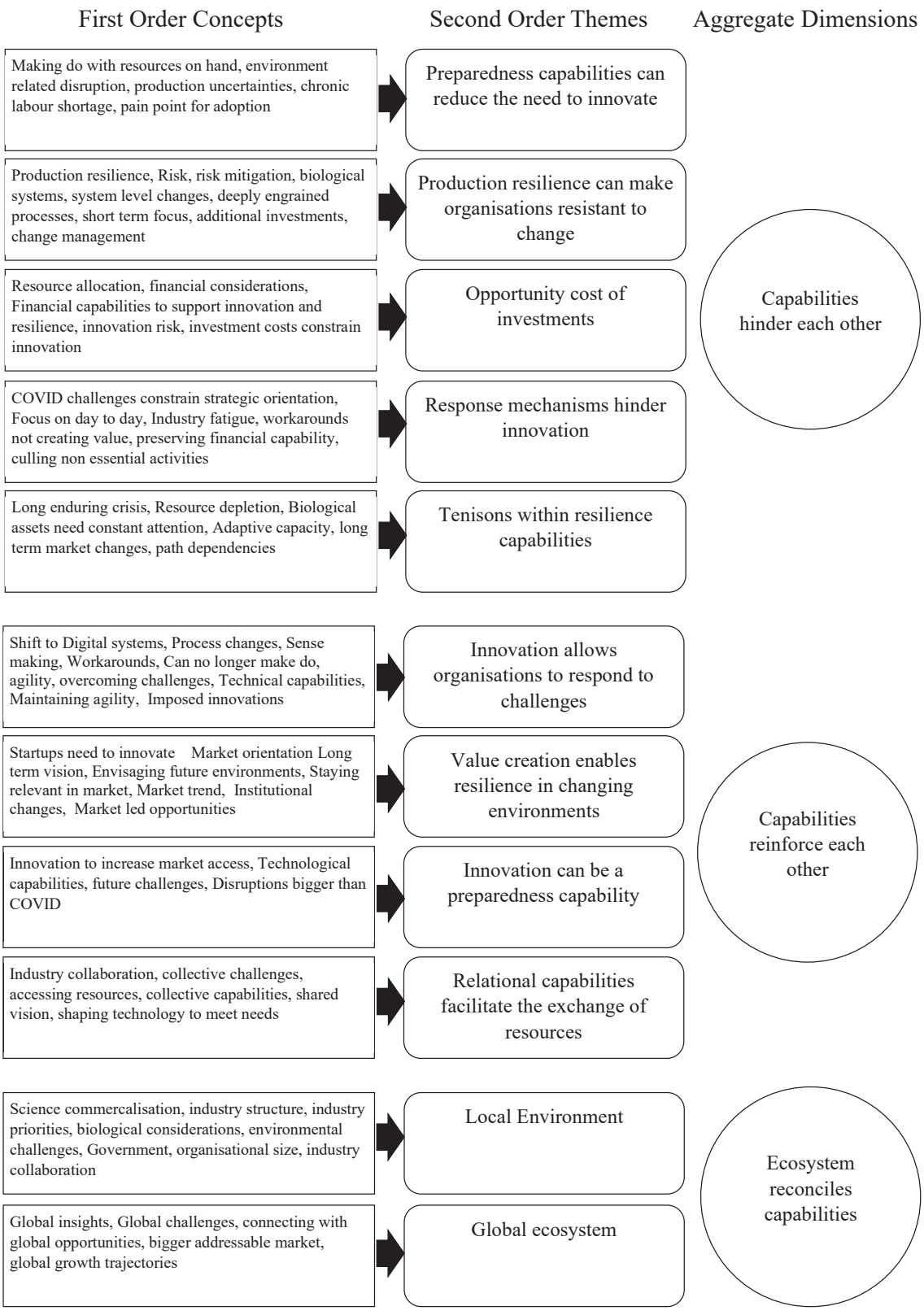
| Primary Data: In-depth interviews. | Interview Period | No. Interviews | Interview Partner | Length (time) hh.mm.ss |
|---|---|---|---|---|
| | 2021 | 14 | Agritech startup 1 | 00.58.14 |
| | | | Agritech startup 2 | 01.13.27 |
| | | | Agritech startup 3 | 00.56.25 |
| | | | Agritech Incumbent | 01.08.34 |
| | | | Large agriculture 1 | 00.55.44 |
| | | | Small agriculture | 01.02.34 |
| | | | Large agriculture 2 | 01.06.13 |
| | | | Agribusiness advisor 1 | 00.53.44 |
| | | | Agribusiness advisor 2 | 00.58.04 |
| | | | Industry body 1 | 00.57.24 |
| | | | Industry body 2 | 01.03.27 |
| | | | Research institute 1 | 55.45 |
| | | | Research institute 2 | 50.48 |
| | | | Funder | 58.15 |
| | | | Total | 13.58.38 |
| | | | Average length | 00.59.54 |
| **Secondary data** | **Data sources** | **No. Sources** | **Year accessed** | **Length (pages)** |
| | Reports | 11 | 2021/2022 | 486 |

## 3.5 Data Analysis

Data analysis was completed using the NVivo qualitative analysis software. Completed transcripts and secondary data sources were imported into Nvivo, where data sources were coded and analysed. This study followed an inductive reasoning methodology in line with the process followed by Gioia et al. (2013). In line with this methodology, an initial round of open coding and first-order analysis was completed. First-order codes were used to reveal themes from the data related to innovation and resilience in the agriculture ecosystem. The first order analysis tried to adhere faithfully to informant terms to develop a rich thematic analysis. As the research progressed, open codes were distilled into higher-order themes and aggregate dimensions (Gioia et al., 2013). When analysing second-order themes, particular attention was paid to nascent concepts or concepts from the literature that emerged in the empirical context. Once this process was completed, the researcher had the basis for building a data structure to outline the study's findings. Gioia (2013) states how a data structure conveys rigour in a study by showing how the analyses progressed. Figure 2 below outlines the data structure used to synthesise the findings of this thesis.

**Figure 3.**

*Data structure of findings*



## 3.6 Limitations

### 3.6.1 Reliability

Reliability in the context of this study refers to the appropriateness of the methods utilised in determining the outcomes and conclusions of the research. Noble & Smith (2015) refer to reliability as the consistency of the methodology and analytical procedures that govern the findings. Shenton (2004) explains that reliability in an idealistic setting would lead to similar findings if the same method and context were used. However, due to the specific contexts in which qualitative research occurs, true reliability cannot be attained (Shenton, 2004). Instead, the researcher maintains reliability by reporting, to the best attempts, the detailed methods used to draw conclusions. This is so that further researchers may be able to replicate the study. Reliability has also been increased by utilising, for the most part, a standardised interview guide.

### 3.6.2 Validity

Validity in this thesis refers to what Noble & Smith (2015) describe as the degree to which the findings represent the data. In other words, validity refers to the credibility or transferability of the findings.

Credibility is akin to validity in how the findings represent the data available to the researcher (Noble & Smith, 2015). The researcher adopted multiple methods to imbue the study with credibility. Firstly, the researcher used secondary resources to triangulate findings from the semi-structured interviews. Credibility was also enhanced by using a diverse population of participants to give their knowledge on the same phenomena. This allowed the researcher to reinforce the findings through multiple data points. Secondly, member checks allowed participants to review their transcripts to reinforce the accuracy of the datasets. Having participants review their interview transcript allowed them to clarify their knowledge and answers to the interview questions. Thirdly, interviews were recorded and reviewed many times to ensure transcription accuracy. The researcher also iteratively reviewed the transcripts through multiple coding rounds to ensure the findings matched the data gathered. Lastly, credibility was built by establishing trust with the interview participants. This ensured the honesty of responses in the interview, increasing the credibility of the data.

Transferability relates to validity in how findings can be generalised beyond the context of the current study (Shenton, 2004). Shenton (2004) highlights the limitations of transferability whereby the findings gathered are contingent upon the context and relativistic setting. As this study is context-specific, the transferability of the findings beyond the current context is limited. The researcher has made the best attempts to enhance the transferability of findings through a multiple case design involving both producers and providers in the agriculture ecosystem. To contextualise the findings, the researcher has provided a rich description of the agriculture ecosystem and the COVID-19 context. In addition to this, long and frequent quotes maintain the authenticity of the data and findings. It also allows the reader of this thesis to assess the degree to which findings can be made generalisable beyond its embedded context (Shenton, 2004).

### 3.6.3 Other limitations

The scope of participants gathered was limited by the effects of the COVID-19 pandemic. Due to the ongoing effects of the pandemic, the ability to recruit participants in accordance with the researcher's preferred list of participants was limited. Prospective participants were too busy dealing with the effects of COVID-19 to give time to participate in this research project. This was compounded by the time of year interviews were conducted. Interviews were conducted in October/November/December of 2021. This time of the year is extremely busy for agriculture organisations, and they could not spare time for activities beyond their current responsibilities. Due to the time constraints of this thesis, interviews could not be conducted beyond the December period.

### 3.6.4 Ethical considerations

This research project was conducted in accordance with the ethical standards set by the University of Auckland Human Participants Ethics Committee (UAHPEC). Under the terms of the ethics standards, participation was voluntary, with participants returning a signed consent form to the researcher. Participants were also advised of their right to withdraw from the study and all identifying information was removed and anonymised. Data gathered from participants was stored on a secure drive which only the researcher had access to.

# Chapter 4: Findings

The findings will be presented in four sections. Firstly, an overview of the agriculture ecosystem and the impacts of COVID-19 will be presented. This will be followed by instances where innovation and resilience capabilities hinder each other, reinforce each other and how the ecosystem supports the reconciliation of capabilities.

## 4.1 The agriculture ecosystem

### 4.1.1 Overview of innovation in agriculture

Innovation in agriculture is essential to the growth and development of the ecosystem. Agritech is seen as a key mechanism for innovation, which is enabled through scientific and technological developments and the successful commercialisation and adoption of technologies. Hence, innovation within agriculture can be examined from several dimensions. Firstly, innovation from the perspective of R&D and the commercialisation of innovations by agritech providers and research organisations. Secondly, innovation from the perspective of agriculture producers who adopt new solutions as part of their strategic activities.

NZ has the potential to develop agritech products that improve agriculture efficiencies and create value through products that could have a global impact. However, the NZ setting has fallen behind relative to the global ecosystem (MBIE, 2020). In 2018, $640m was spent on food and fibre sector R&D. This is well below the OECD average when compared with GDP (MBIE, 2020). In addition to this, a lack of effective research commercialisation results in a deficiency of value-creating agritech products, particularly for the export market (MBIE, 2020). On top of this, NZ agritech organisations tend to work competitively and largely focus on domestic challenges, limiting the scope of innovation (KPMG, 2021).

A number of other issues have been identified that must be overcome for the agritech sector to realise its potential. Prior to COVID-19, the agritech transformation plan was released to overcome these issues and transform the sector. Agritech growth requires a collaborative, ecosystemic approach where innovations in technology, behaviour, regulation and other system elements are needed to drive change (Agritech NZ, 2020).

### 4.1.2 The impacts of COVID-19 on the ecosystem

COVID-19 has had significant impacts on the local and global environment. The crisis has resulted in lockdowns, border restrictions, restricted international travel, and major supply chain disruptions (Agritech NZ, 2020). Many organisations have had to continue operating whilst navigating new operating environments, which has increased the complexity of managing primary production organisations in NZ (KPMG, 2020). As a result, farmers, growers, and other businesses have been praised for their resilience in feeding NZ and the rest of the world whilst the industry battled a 10,000-worker shortage (Hort NZ, 2020). Hort NZ (2020) attributes the sector's resilience to years of developing market-responsive products that have helped the sector remain agile and navigate the disruptions.

The pandemic has also disrupted agritech organisations. In a Callaghan innovation survey, 46% of agritech organisations have been negatively impacted, whilst 25% have been business as usual, and 29% identified new opportunities (Agritech NZ, 2020). Travel restrictions have resulted in limited access to international customers, delayed or cancelled projects and a lack of access to talent. Callaghan Innovation reported that 50% of their customers said that international travel restrictions have negatively impacted their business (Agritech NZ, 2020; KPMG, 2021). Further, Agritech NZ conducted a survey in 2021 that reported 36% of respondents highlighted access to funding as a point of concern. Cashflow issues because of the pandemic emphasises a limited ability of organisations, particularly start-ups, to ride out the storm (MBIE, 2020). Furthermore, as organisations that utilise agritech products are forced to reorient business models and conserve cash, some agritech products may become non-essential or unaffordable.

The pandemic has introduced new challenges to the industry and generated renewed attention towards existing challenges faced by the industry (KPMG, 2021). COVID-19 has introduced challenges such as border restrictions, supply chain disruptions and impacting paths to market. Existing challenges include labour supply and climate change (KPMG, 2021). Nonetheless, the disruptions caused by the pandemic have and continue to amount to ongoing costs of operations which is placing a strain on organisations and the industry (KPMG, 2021). This has highlighted one of the costs of resilience being industry fatigue (KPMG, 2021). As a result of the pandemic, several focus areas have been highlighted: developing and maintaining

resilient supply chains, improving labour availability, and utilising digital technologies across organisational processes (KPMG, 2020).

COVID-19 has also created innovation opportunities as structural and market changes have sparked the need for technological and business model innovations. MBIE has identified key consumer trends that will change the landscape of the agritech ecosystem. Increased attention toward safety, convenience, traceability, environmental impact, and health status of foods is key to the changing landscape (MBIE, 2020). In addition to this, there is an increased preference for value-added products and experiences surrounding food and beverages. Non-consumer-driven trends relate to geopolitical volatility, labour supply, workforce demographics, labour supply and climate change (KPMG, 2021; MBIE, 2020). Many of these trends were identified before the pandemic and have accelerated mainly as the world focuses on global food security and other relevant issues.

Opportunities within the agriculture ecosystem are evolving at a rapid pace. Global innovation opportunities are being driven by increased investment and government initiatives to respond to challenges exemplified by COVID (MPI, 2020). NZ organisations can contribute to and participate in the system-wide transformations occurring. The primary sectors have the potential to extract greater value across the value chain by being innovative and responding to market needs (MPI, 2020). However, there is a tension in the agriculture sector which is operating under significant pressure. The wide range of day-to-day issues that sector organisations must deal with has placed a great amount of strain on the industry, constraining the ability to capitalise on opportunities (KPMG, 2021).

Table 5 below outlines the innovation opportunities and issues that exist within the agriculture ecosystem and how the ecosystem has been influenced by COVID-19.

**Table 5.**

*Innovation opportunities, issues and the influence of COVID-19*

| | Innovation in agritech | Source | Influence of COVID 19 | Source |
|---|---|---|---|---|
| Critical innovations | Innovation in agritech is mainly focused on increasing productivity and production efficiencies. Agritech can also facilitate the shift from volume to value-creating processes and products. | Agritech NZ, 2020; KPMG, 2020, 2021; MBIE, 2020 | Border restrictions have constrained the inflow of transitory and skilled labour, which has exacerbated already existing labour shortages in the sector. | Agritech NZ, 2020; Horticulture NZ, 2020; KPMG, 2021 |
| | Sensors, data analytics and AI-based solutions empower new levels of control and insight for growers, particularly with production optimisation. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020; MPI, 2020; TIN, 2020 | Closed borders have limited overseas travel for organisations and introduced challenges for accessing overseas markets and stakeholders. | Agritech NZ, 2020; KPMG, 2020; MBIE, 2020 |
| | Robotic and Automation innovations work alongside human capital to optimise the supply chain. These solutions also allow human capital to be orientated towards high-value products. | Agritech NZ, 2020; Hort NZ, 2020; MBIE, 2020; TIN, 2020 | As countries are focused on their own food system resilience, global organisations are becoming increasingly insular. | Agritech NZ, 2020; KPMG, 2021 |
| | Digital tools facilitate transparency along the value chain and help to build consumer trust. | Hort NZ, 2020; Horticulture NZ, 2020; MBIE, 2020; TIN, 2020 | Many global megatrends in food production have been amplified; Focus areas remain around food traceability and sustainability of consumer buying decisions. Concerns around global food security and safety have accelerated the need for production and traceability based innovations. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020 |
| | Gene editing and biotechnology solutions allow new value-added; food, production techniques, product categories, crop varieties | KPMG, 2021; MBIE, 2020 | Global supply chain disruptions have forced organisations to rethink how they access resources and supply international markets. This has also resulted in an increased reliance upon NZ production organisations to serve the immediate needs of the population | Agritech NZ, 2020; KPMG, 2021 |

| | | | | |
|---|---|---|---|---|
| Innovation Drivers - Megatrends | Climate change: Primary industry productivity is the most susceptible to the effects of climate change. Innovations that increase the resilience of farming and processing systems against climate will reduce future uncertainty in the global agri-food system. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020 | Public health measures have changed the way organisations can operate. These include the likes of physical distancing and strict health measures that are imposed by both domestic and export-related regulations. | Agritech NZ, 2020; Horticulture NZ, 2020; KPMG, 2020 |
| | Population Change: As the global population increases, the food demands will also increase. There needs to be innovation to establish a more productive and efficient food system to meet food challenges. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020 | Social isolation and lockdowns have accelerated digital adoption for consumers with the exploration and purchase of products occurring online. | Agritech NZ, 2020; KPMG, 2021 |
| | Consumer demand: There is a shift in the consumer landscape toward value-added foods such as; high nutrition foods, alternative proteins and convenience meals. | Agritech NZ, 2020; Hort NZ, 2020; KPMG, 2020, 2021; MBIE, 2020; MPI, 2020; TIN, 2020 | | |
| | Production and supply chain sustainability: There is increasing pressure from social and regulatory authorities to produce food more sustainably. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020; TIN, 2020 | | |
| | Data and consumer awareness: Consumers are becoming increasingly aware of the products they consume and demand certain attributes from their products. There is also an increased focus on the trustworthiness of data. Organisations need to innovate to maintain a social license and become competitive on a global scale. | Agritech NZ, 2020; Hort NZ, 2020; KPMG, 2020; MBIE, 2020; MPI, 2020 | | |
| Issues | There is a disconnect between R&D and commercialisation outcomes. NZ has made significant investments into agritech R&D. However, research outputs do not extract their full value potential. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020; TIN, 2020 | Travel restrictions and uncertainty have impacted the ability of organisations to engage with overseas stakeholders meaningfully. | Agritech NZ, 2020; MBIE, 2020 |

| | | | | |
|---|---|---|---|---|
| | NZ's naturally productive landscape has meant that organisations rely less on agritech to drive productivity. This has placed NZ behind global leaders in agritech solutions for primary productivity. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020 | Challenges with international connection have resulted in decreased sales, cancelled projects, reduced business opportunities and reduced international investment. | Agritech NZ, 2020; MBIE, 2020 |
| | The domestic focus of agritech solutions has limited the scope and global demand of NZ agritech. Innovators are not looking beyond the NZ context for problems to solve. This constrains the ability of NZ agritech to apply to global systems. | Agritech NZ, 2020; KPMG, 2020; MBIE, 2020 | End users delay investment in new technology, tools and services as they prioritise investment on overcoming immediate challenges and uncertainties from COVID. | Agritech NZ, 2020; KPMG, 2021 |
| | Large organisations in the ecosystem do not develop solutions with a broader focus than their own production needs. | (Agritech NZ, 2020; MBIE, 2020) | Many agritech start-ups/SMEs have reported funding constraints due to investment challenges or revenue disruption. There is an increased reliance on financial support from the government/other funding mechanisms | Agritech NZ, 2020; MBIE, 2020 |
| | The competitive nature of the domestic agritech market leads to a lack of cohesive solutions and limited information sharing. This reduces the interoperability of offerings and increases the number and complexity of solutions that producers must contend with. | Agritech NZ, 2020; KPMG, 2021; MBIE, 2020 | Startups are constrained by negative impacts and are less likely to be able to ride out the storm due to short cash flow runways. | Agritech NZ, 2020 |
| | Many agritech propositions are point solutions to problems. This leads to a disconnect between the proposed offering and its implementation alongside other offerings. This has led to a market where products and services are not compatible and increased risk of stranded assets due to incompatible technologies. | (Agritech NZ, 2020; KPMG, 2021; MBIE, 2020) | Immediate impacts of labour constraints have required organisations to prioritise resource allocation over volume rather than value-creating activities. | KPMG, 2021 |
| | There is a general absence of growth capital in the NZ market for organisations to scale up and drive the adoption of value-creating solutions. | (Agritech NZ, 2020; KPMG, 2021; MBIE, 2020) | The operating environment changes brought about by COVID has driven short-term thinking to overcome practical challenges. The focus on short term workarounds has constrained the | |

| | | | | |
|---|---|---|---|---|
| | | | ability for management to focus on long term opportunities. | |
| | Adoption issues e.g., cost, skills and infrastructure, had led to slowed uptake of technologies and inhibited agritech growth and producer optimisation. | (Agritech NZ, 2020; KPMG, 2020, 2021; MBIE, 2020) | | |

## 4.2 How the broader institutional environment can hinder innovation

### 4.2.1 Current institutional environment

The current institutional environment provides the context for the capabilities that organisations within the NZ agriculture ecosystem build and deploy. The NZ agriculture ecosystem is nuanced and complex. The ecosystem is structured into industry segments–for example, pip fruit, wine, and kiwifruit– each of which has its own innovation drivers and challenges that they must overcome. The industry structure and institutional environment affect the innovation patterns and interactions within the ecosystem.

When it comes to agritech based solutions, the ecosystem generally operates on a linear, adopter-provider innovation process. Innovative activities for agritech providers focus on creating new products and processes marketed toward agriculture producers. On the other hand, producers typically adopt technology that helps them overcome challenges or increase production efficiencies. Producers also engage in R&D and commercialisation activities orientated towards biological elements, for example, new plant varieties or enhancing the resilience of plant stock.

> *"In the vineyard space, it's most of the projects that we do involve a third party to be fair. There is typically always someone, always a third party who is providing a service ultimately, so." –Large agriculture 1*

> *"We are, Industry Body are primary shareholders of that breeding program. So, our funds go into that to generate new varieties that might be more commercially productive or new traits." –Industry body 1*

Each industry segment has its own innovation priorities. The agricultural producer interview partners were primarily from the Wine and Pip fruit industries. Innovation priorities in the wine industry are focused on maintaining the quality of NZ's most prominent wine exports (Sauvignon Blanc and Pinot Noir). Organisational priorities also differ between large and small organisations and by region. Big Wine organisations are innovating to achieve efficiency. Smaller producers focus more on traditional winemaking for 'wine tourism'; therefore, the need to utilise agritech in their organisations is less imperative. Regional differences are also significant in the wine industry, as they constitute different growing conditions and environmental challenges that agritech can address.

> *"But a lot of the research in New Zealand is based around what makes us the most money as a country, and that's mostly Sauvignon Blanc and Pinot noir down in Marlborough, Central Otago, and sort of the bigger regions so. So, it's not a lotta research or innovation specifically that gets focused on sort of smaller boutique operations, and more so actually Waiheke." –Small agriculture*

In the pip fruit industry, innovative activities are targeted toward market access, developing unique cultivars, and crop management practices that allow the industry to expand into more markets and fit with imposed requirements that could pose a market access risk.

> *"I guess, prioritise what we invest funds in for the industry in terms of what their needs and priorities are for research. And that primarily is focused around for us as an organization, making sure that our growers have market access. So, it gets, so for that It's primarily like…I guess requirements to meet offshore markets..." –Industry body 1*

### 4.2.2 Science commercialisation as the typical innovation route in NZ

The innovation process for NZ agriculture typically starts within research institutes, embedded in both academic and commercially driven research. Research is conducted through Universities, Crown Research Institutes (CRI's), or Industry-academia partnerships. Research and innovation created in these entities can follow multiple routes to industry, either through spinouts, startups, incumbents, licensing deals or through more passive channels. Findings show that the current science commercialisation pathway is repetitive and often yields similar results. The current innovation process stagnates the ecosystem's growth, and a change in mindset is needed to achieve the growth potential of the ecosystem.

*"So, you get the traditional route it like Ag research does a project and get some interesting science or a PhD student does something and then a couple of people decide to turn it into a business and maybe someone leaves Ag research to help build it. Then they turn it into a few $100,000. They might get a big kind of farmer conglomerate or something to invest a bit of money in it and you end up with a sort of a few $1,000,000 business; a few directors that might be ex Ag research or ex LIC or whatever it is. And then they turn it into a few $1,000,000 business in NZ. But it's kind of like you see the same thing over and over again." –Agribusiness advisor 2*

Despite the successes that can arise from science commercialisation in NZ, findings show that there are still many issues within the ecosystem.

The commercialisation of science tends to produce products and services rooted in complex academic research and technical superiority. Furthermore, academia typically lacks an understanding of the ecosystem's inherent problems. Consequently, many agritech innovations provide point solutions and lack a cohesive value proposition to warrant adoption. As most startups or innovative products in the NZ ecosystem are either spun out of Universities or Research institutes, they often lack the capabilities to create value. It is essential to understand how value can be created through 'turn key' solutions and articulate this to customers, to facilitate the successful development and commercialisation of innovation. Furthermore, developing capabilities that enable value creation is imperative to solving this issue.

*"I think they need to recognize that actually very often they don't have a whole of system solution. They've got a point solution to a problem… they're not commercial from the core, they're scientists that have come up with a good idea. And you know they're as they're solving a point problem in a value chain. As opposed to giving the grower or the farmer a system solution to enable them to integrate various pieces of technology to cause a step change." –Agribusiness advisor 1*

Research institutes also face the challenge of getting technological innovations to a point where they are acceptable for investment. With science-based innovation, the first commercial transaction can be at significantly different points along the innovation pathway; for instance, selling a product vs selling know-how needs different capabilities and risk appetites to initiate the first commercial transaction. Innovations that come through research institutes have been criticised for not progressing far enough down the commercialisation pathway for producers to invest as customers. Producers do not see the value in supporting the

innovation at such early stages of commercialisation due to the risk involved and additional capabilities that need to be developed to advance it to an in-market product.

One producer mentioned an instance where they were happy to facilitate the commercialisation of early-stage technology. The technology was being brought to the organisation through a company, and the organisation could see where the technology would create value. Furthermore, supporting the commercialisation as a customer allows the producer organisation to influence the development of the product to suit their needs.

> *"Yeah, and I mean it's a bit of a gap at the moment. It's 'cause it's, like it's evolved quite quickly. And just getting things from technical, academic sort of R&D phases through to commercialization. And it's sort of missing that link in between where you're going; Well, we don't wanna be a blady blah investor and producer of that, but if there was a company bringing it to us, that would be a lot more attractive." –Large agriculture producer 1*

Innovation in the agriculture industry operates on longer timelines due to the biological systems inherent to the ecosystem. Several examples of why innovation operates on a longer timeline is included below:

1) Plant systems can take years to establish. Thus, the outcomes of innovation can take years to reveal themselves.
2) Cultivar innovation requires multiple generations to express new traits. In addition to this, plants can take years to grow, and any modifications done
3) The seasonality of crops means that the development and validation of innovations can only occur during specific windows.

Many of the innovations in agriculture need longer innovation timelines. Longer timelines are often outside many producer organisations' strategic and investment scope. When innovation opportunities lie outside the organisation's strategic priorities, the ability to see them as beneficial can be constrained by the perceived immediate need. For providers, this means they have to demonstrate the value of the technology and manage adopters' expectations for the value that the technology creates for the organisation.

Environmental challenges are another important consideration within the agriculture ecosystem. Technical capabilities need to be deployed to suit different environments. There is

a range of growing environments (orchards, vineyards) that require different technical capabilities. In addition to this, many 'lab based' innovations do not translate well to the real-world environment. This often means that many technologies do not meet environmental requirements for a producer. From a provider perspective, particularly those in automation or engineering-based areas, this means the ability to adapt technology in line with environmental considerations is key to creating value for prospective customers.

> *"Unfortunately, you know, like a lot of the, those bigger equipment and technology that exists is. It's just not practical at all for the sites sizes on Waiheke. And also the, we've got some really diverse terrain in terms of steep slopes, short vine rows, and sort of pretty small headlands." –Small agriculture*

### 4.2.3 Inconsistent impacts of COVID-19 across the ecosystem

COVID-19 has had inconsistent impacts across the ecosystem and throughout time, which has provided different contexts for capability deployment. Border closures, national lockdowns and subsequent regional lockdowns have introduced uneven challenges that have affected organisations differently. Agriculture producers were deemed essential services and were able to continue operating during the lockdowns. For some organisations, sales have dramatically increased, meaning response mechanisms have been aligned with maintaining supply. This has been particularly relevant with large wine producers who sell wine through supermarkets.

On the other hand, many organisations have also experienced a significant loss in sales, such as smaller wineries that could not sell wine through their usual channels. In this case, response mechanisms have aligned with survival. Whether sales increased or decreased, most organisations have had to deploy resilience mechanisms in some capacity to overcome their organisational challenges.

> *"Around half the wine industry has done incredibly well. It's the bigger producers with large volumes. They can go to a supermarket and they can do a, you know 50,000 or 100,000 case transaction. So it's a very inconsistent impact." –Agribusiness consultant 1*

For agritech providers, COVID-19 has impacted sales and commercialisation pathways. Producers dealing with the day-to-day management of COVID do not have the

capacity to invest in new technology. The closed borders have made it difficult for global facing providers to access overseas markets and customers. The challenge has been compounded as the rest of the world learnt to live with COVID whilst NZ was locked down. Despite sales taking a hit in some areas, other areas benefited as producers were faced with challenges that needed agritech solutions to overcome.

> *"You know particularly not being able to travel has meant you know it's no secret that we've, well maybe we don't pass it around, but we've taken a hit on sales, not being able to… Oh sure, yeah, for us it's meant pre COVID everything was just about sales, sales, sales, sales, sales, sales, COVID hit. We couldn't get to key markets and two of our distributors just kind of kick the bucket. You know their sales were down massive in market, particularly to wineries" –Agritech startup 3*

The impacts of COVID-19 have been inconsistent across the board. Despite the inconsistencies, many long-term issues have been highlighted across the ecosystem which can no longer be ignored. One of the biggest realisations for producers was that they can no longer make do with the labour shortages they had previously been dealing with. With the closed borders keeping out seasonal workers, producers have had to look elsewhere for labour or make do with the labour they had. Many organisations have reported huge production losses as the labour shortage has resulted in fruit being left on the vine to degrade. The lack of 'cheap' labour has also increased ongoing labour costs as workers are in significant demand.

> *"So, I think some of the things coming out of this are really long-term issues. So, you know one is the labour issue. And you know it's very clear we're having a reset in respect of Labour availability and how much labour will be allowed to come into the country. So, you know, that's creating a need to start to rethink what processes are done manually and what processes are done through automation in our say, or horticulture sector. So, I think that triggers a whole long-term pipeline of innovation that will need to be done, but it's not something that can be done overnight." –Agribusiness advisor 1*

### 4.2.4 NZ's response to COVID-19 has reinforced its distance from the world

Findings show that prior to COVID-19, NZ's distance from the rest of the world and institutional settings put it in a 'bubble'. This bubble poses a problem for agritech innovation whereby innovators are inherently insular and solve domestic problems. They lack exposure to

global issues and opportunities that can inspire innovation. Innovators also lack the capabilities to translate their products into offerings that fit global needs.

NZ's response to the COVID-19 pandemic, like many other countries, was to close the borders to stem the flow of people into the country. The government viewed this as a way to minimise the impact of the virus on the NZ health system. NZ's lockdown has impaired its ability to engage with the rest of the world. As the pandemic has endured, the rest of the world has opened up whilst NZ has remained on lockdown, reinforcing the disconnect between NZ and the rest of the world. Border closures have constrained the flow of much-needed talent into NZ. For example, tech talent levels have been pushed to critical levels, leading to a digital skill crisis (NZTech, 2021). With a lack of talent, organisations find it challenging to engage in value-added activities. Furthermore, organisations are constrained in their ability to reach international customers. While digital platforms have somewhat alleviated this, challenges have persisted. Perhaps the biggest issue is that NZ is further from the world regarding insights and developing an understanding of how the world has changed. This has created a disconnect between the NZ ecosystem and the international community it hopes to serve.

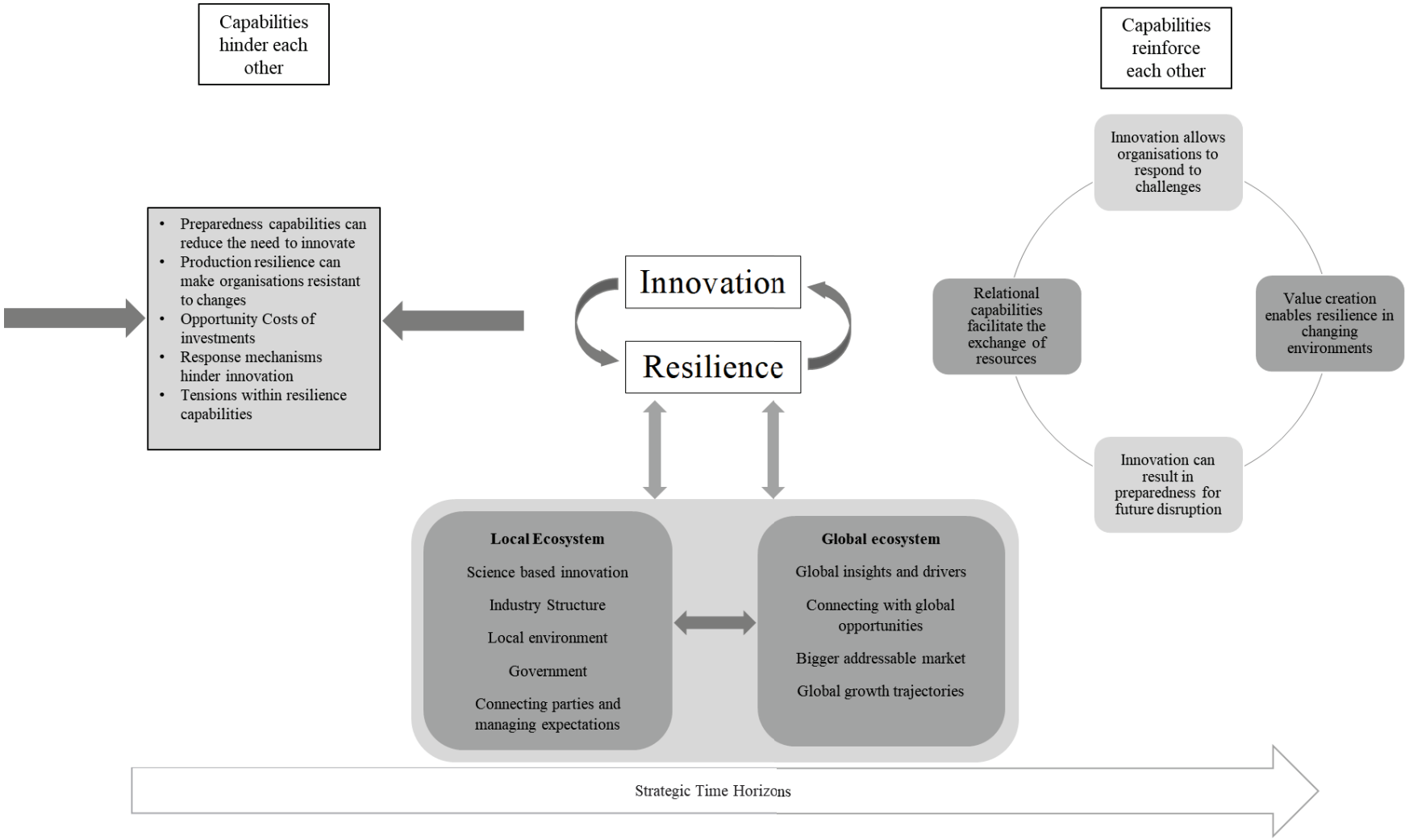
## 4.3 A framework to explain the interaction between innovation and resilience

The findings of this study show that many innovation opportunities exist for the NZ agriculture ecosystem. Some of these opportunities existed before COVID-19, and some have been generated as a result. However, the findings show that the current institutional environment does not support innovation and promotes resilience. In response to the COVID-19, many organisations have had to implement changes to operate in new working conditions. Further, the resilience capabilities deployed to respond to the disruption caused by COVID-19 have also constrained some organisations' ability to engage in activities for innovation. These examples portray the complex interaction between innovation and resilience revealed by this study. Figure 2 below presents the framework that will be used to explain the interactions between innovation and resilience as they have appeared during this study.

The left-hand side of the framework presents the tensions or hindering elements of innovation and resilience. The right-hand side of the framework presents instances where innovation and resilience reinforce each other. The bottom element provides the contextual

elements that provide the context for reconciliation of innovation and resilience capabilities. The context is supported by both the local and global environment. Lastly, capabilities depend on the strategic time horizons of organisations and other ecosystem actors; they determine how capabilities are built and deployed over time.

**Figure 4.** *Framework for interactions between innovation and resilience in the agriculture ecosystem.*



## 4.4 How do resilience and innovation capabilities hinder each other

### 4.4.1 Preparedness capabilities can reduce the need to innovate

Organisational investment in preparedness capabilities can reduce the need to innovate where imposed pressures do not impact the organisation. As land-based producers, agriculture producers must cope with variable environmental conditions (severe weather events, low yielding seasons, crop loss). Thus, they develop capabilities to mitigate the impacts of environmental conditions on their operations. As producers are used to dealing with disruption and constrained resources, they can often make do with the resources they have on hand. The ability to 'make do' can result in a tension where producers often do not see the need to innovate, or there is not significant enough pressure to force producers to adopt new practices.

> *"Seed production can be a bit funny. Some of our seeds are from plants that can be frost sensitive. And we when you're growing that raw seed to begin with, an out of season frost can actually destroy your years production." – Large agriculture producer 2*

A pertinent example of the ability to make do in NZ is with regards to the chronic labour shortage in the horticulture industry. Preparedness capabilities allow managers to adapt to conditions and account for changes in labour supply (New Zealand Institute of Economic Research, 2020). This means the pressure is not significant enough for many organisations to see the need to change practice, which has slowed the development and adoption of technologies targeted toward addressing the labour shortage. Furthermore, a low-cost migrant workforce has somewhat relieved this pressure, allowing producers to make do with the resources they have on hand (Agritech NZ, 2020). This presents a problem for agritech providers trying to target producers who are not at the pain point where they are ready to adopt new technology.

> *"You know trying to scale that R&D required for the industry when the industry is not quite at the pain point where they want to support it. And to be fair, the pain point where they want to support it's probably a year after they should've had it… And that's what I hear every year. "Oh, actually we're gonna push that to next year, 'cause we're just, we're just going to make it work with the people we've got" And your like "seriously, did it work last year?" "No", "have you got more people", "no", "OK, right cool." –Agritech startup 2*

### 4.4.2 Maintaining production resilience can make organisations resistant to change

Findings have shown that agriculture producers tend to focus on production resilience, which is inherent to organisational resilience. Needing to maintain production resilience can make producers risk-averse when it comes to technological innovation and subsequently resistant to change. This is particularly relevant for technological innovation that is new or untested within the ecosystem. Any undue risk introduced into the value chain must be carefully assessed. This introduces a tension between producers and providers whereby producer organisations are hesitant to invest in innovations that may risk production resilience or require other system changes.

> *"Horticulture is, agriculture in general is the worst area for innovation because the whole, the whole, the whole culture around it is quite conservative. People don't really try to try new things unless it's like really, really proven to be OK." –Agritech startup 1*

The focus on production resilience shows that producers are inherently short term focused. As most producers are typically focused on the productive cycle, their activities and planning horizons are aligned to production. Short-term time horizons in producers constrain the ability to look beyond the immediate future and envisage the industry's future environments. In this case, long term innovation is constrained due to the focus on short term operations.

> *"I think the simple reason is that we have been highly focused historically on the productive cycle. So, we've set our planning horizons aligned to production. Because we've been about producing and then finding somebody to sell to. Or exit the product to get it into market. And I think, you know, inherently we have been rooted to production. That is changing and it's changing slowly. But there's a lot more we need to do." –Agribusiness advisor 2*

Land-based producers have many deeply engrained systems and processes critical to the production of primary produce. The systems put in place by producers for their production resilience can make them resistant to change. Trying to integrate new technologies into already established practices can disrupt the equilibrium, posing a threat to production resilience.

Investment in a focal technology introduces risk and often requires further innovation and investment in other system elements. For example, incorporating technology such as automation into a farm may require changes in farm structure (layout of trees, row sizes,

compatibility of produce with technology). The long timelines for establishing farm systems mean that changes need to be carried out deliberately and gradually with minimal disruption to production. Automation also requires changes in management practices and employee upskilling to facilitate the use of automation technologies (New Zealand Institute of Economic Research, 2020). These considerations are essential in communicating the value proposition of new technologies to facilitate their adoption.

> "*So, it's huge costs to develop something like that. And then there's all these other things that have to come along with it. So, to have an automatic pick, like robotic picker, you have to have like 2D systems. And only about 10 to 20% of our plantings are in appropriate systems. So, we've put apple trees in the ground and it will be there for like 25 years. So, it's it takes time to convert all your orchards and money to get to your orchards in a…I guess in a structure that will be allowable to use that technology as well. So that's another. That's another huge cost to be able to even get your orchards 'robot ready." –Industry body 1*

### 4.4.3 Opportunity Cost of investments

Opportunity costs can reflect trade-offs organisations must make between their investments in innovation and resilience. Organisations have a finite amount of resources which means they must consider the activities they use their resources for and the alternative activities in which those resources could be invested. Similarly, decision-makers must determine a way forward with their available resources when considering an organisational response to disruption.

A common theme for opportunity cost in the agriculture ecosystem is the financial considerations of investments. Financial capabilities are integral to both innovation and resilience; they give organisations the ability to invest in innovation and provide financial slack for everyday activities and potential disruption. When an organisation decides to invest in innovative activities, it must also consider the alternatives to innovation and how innovation may affect the organisation.

One of the considerations provider organisations make regarding opportunity cost is whether they have the financial capabilities to support innovation. In order to engage in R&D and commercialisation activities associated with innovation, funding is required from internal or external investment. The availability of capital to engage in activities can determine the

organisation's innovation capacity. Organisations must also consider whether it is worth their while to invest in innovation which carries an inherent risk.

> *"You know it's a business so it has to make money. So yeah, we, it's a fine line between balancing what we progress and how we progress versus, you know, at what point like I said, do we just shelve it and say, hey, it's actually not worth our while. Because financially I can make you know more money if I didn't invest into R&D. We already have a product line that sells. Why not to sell it and not worry about the other side." – Agritech startup 2*

In smaller producer organisations, the investment cost in technology-based innovations often constrains the ability to adopt innovations. This is particularly relevant with expensive newly developed technology such as automation or mechanical based innovations. Due to the cost of adoption and the seasonal nature of production, many organisations cannot justify the investment in expensive equipment, particularly where it is only in use for a short period (New Zealand Institute of Economic Research, 2020). In addition to this, short term time horizons often mean that organisations do not have the capacity to invest in long term innovation.

> *"Yep, yeah and then that's the big key with it I think is actually making it, 'cause they're bl***y expensive pieces of kit. It's fair. I mean you know 200K or so probably for a platform. But you know, and some of these orchards are gonna need 20, 30, 40, 50 of them. So that's a lot of money." –Agritech startup 2*

### 4.4.4 Organisational resilience mechanisms hinder innovation during COVID-19

The organisational response to COVID-19 has hindered innovation in many organisations. When COVID-19 first initiated a crisis level event, decision-makers had to assess the current environment and deploy the necessary capabilities to survive. Organisational strategies and response mechanisms have been varied throughout the COVID-19 pandemic. There have been inconsistent impacts of COVID across the ecosystem, and the progression of disruption over time has influenced the context for deploying capabilities. Despite this, core themes prevailed where the response to COVID has impacted the capacity for innovation.

COVID-19 has revealed a tension between innovation and resilience, whereby overcoming challenges associated with COVID-19 has constrained the ability of organisations to recognise and respond to innovation opportunities (MPI, 2020). In light of this, the response

to COVID-19 to ensure agility and resilience has driven short-term thinking, with organisations planning on a day-to-day basis, rather than months or years. Addressing short term problems and prioritising resources toward essential activities has made it challenging for management teams to focus on long term opportunities and aspirations for the organisation.

> *"So there is some organisations that are dealing with logistics and like supply chain logistics and lack of workers and stuff has caused huge headaches and they are they've been really suffering. They've been focused on the day to day and they've been like head basically down not looking at the future, not strategizing and so on." –Agribusiness advisor 2*

The agility required by organisations that enable their continued operating often involved workarounds. As discussed earlier, some workarounds have enabled organisations to bounce forward. Findings have also shown that workarounds implemented to continue operating have also come at the cost of value-added activities as provider organisations had to redesign components to produce existing offerings. In producer organisations, the shift to unskilled domestic labour streams has meant that high value produce and value add opportunities have been neglected. Whilst workarounds allowed organisations to continue operating, the long-term value creation activities have been constrained.

> *You know the resilience side of things I think means that yeah, people haven't been stopped in their tracks. They found work arounds. They've been able to get new tools, but it doesn't, but they're still doing things that are, you know, you would say they're necessary obviously. But they're non value add. And that's a that's a challenge." –Industry body 2*

Cutting costs was another common measure of resilience that allowed organisations to preserve their financial capability. This also meant that many organisations did not have the funds to engage in innovative activities. The financial capability to withstand the impacts of COVID-19 was seen as a pertinent theme across all organisations. Both large and small organisations have been focused on maintaining the financial capability to survive should COVID-19 dramatically impact their organisation. The need to make their organisations 'financially resilient' meant that decision-makers culled many non-essential activities. In this sense, the need to maintain cash reserves for essential activities constrained the innovative activities of some organisations.

*"So I think personally, am I seeing dramatic innovation in organisations, who are not at the moment? 'cause most of them at the moment are looking to make sure their balance sheets are quite resilient. They're managing their capital spend, they're wanting to ensure that should another wave of COVID come that is worse than what we've already seen, which is a possible scenario then they've got the resilience to be able to stand up and survive again" –Agribusiness advisor 1*

Within agritech organisations, one of the most significant impacts of COVID-19 has been decreased sales. In addition, lockdowns meant that staff had to work from home and could not enter R&D labs. With a lack of cash flow coming into the business, non-essential R&D activities must be evaluated. This is because the financial capabilities that organisations do have are being used to engage in essential activities needed for survival. For Agritech startup 2, the high investment cost in innovation activities means that R&D activities can only be done with funds available. Like many other startups and SMEs, this tech provider operates on lean financing. They use their existing product base to generate revenue where profits are spent on R&D. During COVID when sales were down, organisations did not have the financial capabilities to fund innovation. Cash flow was directed towards the day to day running of the business.

*"Cashflow sucks. But you know, and that's the thing...Is our future R&D that much further behind? Uhm? You know, and it is." –Agritech startup 2*

Similar themes were seen in agriculture producers, especially in smaller wine producers whose sales were impacted dramatically. For these organisations, the emphasis was on workarounds that would allow them to conserve cash and generate cashflow. This also means that they do not have the financial capacity to invest in new technologies.

*"What we've got is a challenge in the industry, is a lot of small vineyards, and COVID has made life even more difficult. Who are not very profitable if profitable at all. And then you know, they don't have the resources to innovate as easily." –Research institute 2*

Financial capabilities in larger organisations allow them to weather out the storm; therefore, agility is not as important. Incumbents' financial capabilities give them a greater buffer to survive a crisis and make them less volatile and more resilient as a crisis unfolds. Conversely, the ability to survive the crisis can also reduce the need to innovate in incumbents

as they have survived the crisis. This leads them to believe that current practices are appropriate for their environment.

### 4.4.5 Tensions within Organisational resilience capabilities

The findings from this study have revealed that investment and deployment of organisational resilience capabilities can also impede resilience.

When COVID-19 first came to the fore as a crisis level event, there were many different perceptions of how the crisis would unfold. According to Agribusiness advisor 2, there were three categories of organisational strategy in their agriculture customer base 1) A wait and see strategy, 2) A short term strategy, and 3) An all-inclusive strategy.

> *"But some people are kind of looking at doing their strategy, but they want to wait until COVID has gone. And then they're going to do their strategy. Because for now it's just day-to-day. And then there's others that have kind of realized we need a strategy that's going to deal with the short term and the long term. And then there's others that want to make just a more all inclusive strategy which is setting them up for the long term future right through from now. So people segment; people wanting to forget the future, people segmenting the future or people including the future." –Agribusiness advisor 2*

Many organisations thought the COVID-19 crisis would blow over, and it was a storm they could weather. In this case, managers foresaw the preparedness capabilities built over time as sufficient to carry the organisation through the disruption or avoid disruption entirely. Based on these assumptions, these organisations deployed their resilience capabilities to conserve cash, cut costs and employ workarounds to survive the disruptions.

In 2022, the COVID-19 pandemic is entering its third year. COVID-19 and its associated economic and societal consequences continue to pose a threat, and organisations are still in a mode that promotes resilience and conservativeness (World Economic Forum, 2022). As the crisis has endured, the capabilities and resources deployed by many organisations are starting to run thin. Riding out the storm ensues that some capabilities utilised by organisations to enhance resilience when disruptions are transient can hinder the ability to maintain resilience to crises that persist beyond the foreseen time horizon. This is especially important in agriculture producer organisations where biological assets need constant upkeep and maintenance.

*"The vineyard yeah, you can't just, you can't just mothball. So we can't just go. You know, restaurants at least you can mothball, and you can say; OK well there's no business at the moment, we will just close it up. And yeah, OK guys yeah. You know you can't do that with a vineyard or winery 'cause you've, you've gotta keep on putting money into it" –Small agriculture*

The investment in capabilities for preparedness and agility to survive and or mitigate disruption can hinder the adaptive capacity of organisations. COVID-19 has resulted in an environment where many institutional arrangements have shifted. The short-term focus of organisations and the deployment of resilience capabilities to mitigate disruption may inhibit organisations' ability to respond to more permanent market-level changes. Maintaining resilience whilst failing to adapt to the changing environment can put organisations in a position where they may no longer be resilient in a changed institutional environment. As organisational resilience is waning, organisations are realising now that they need to adapt. The actions taken in the organisational response to COVID-19 could result in path dependencies that threaten the organisation's ongoing resilience.

*"Yeah, I would say there's like, we would call the business as usual ones, those that've tried to weather the storm. And they then now just having to lean into the fact that it's changed." –Agribusiness advisor 1*

## 4.5 How do innovation and resilience capabilities reinforce each other

Findings show that certain resilience and innovation capabilities elements can reinforce each other. Inherent to the reinforcing mechanisms is the ability of organisations to orchestrate their resources, identify opportunities and orchestrate the required transformations that allow organisations to interact with their environments (Teece and Brown, 2020).

### 4.5.1 Innovation allows organisations to respond to challenges

Findings show that innovation allows organisations to respond to challenges. COVID-19 has introduced many challenges to organisational operation. Consequently, organisations have had to innovate with process changes and workarounds to navigate challenges and continue operating. The ability to innovate in response to disruptions is enabled by a combination of cognitive, behavioural, technical, and financial capabilities that organisations

deploy. The researcher observed that imposed innovations have not necessarily been 'new' in the spirit of the definition of innovation. However, they have reflected the use of novel resources that have allowed organisations to remain agile and respond to the disruption caused by the crisis.

> *"And what they are looking for is to become more agile, more flexible, and looking for where the quick wins are in terms of innovation. So, if there's something they can do in terms of digitalization or automation. That enables them to just lift that resilience 1,2, 3 percent. Then they are taking those opportunities now." –Agribusiness advisor 1*

A pertinent example of rapid innovation in the COVID-19 environment has been the mass adoption of online platforms in organisations. Structural pressures have forced organisations within the agriculture ecosystem to adopt digital platforms on a mass scale. Many of the digital adoptions focused on complying with government COVID policy. Others were to reach locked down customers via digital sales channels. Some of these changes have been temporary workarounds that are likely to fade into the background once the crisis has blown over, whilst others have been permanently embedded into new ways of operating.

> *"… So, you know, there's lots of little things like that where we utilized technology or new, newer well, tools to get things done. And without them, it would have been really difficult to be fair." –Large agriculture 1*

Other digital innovations included adopting video telecommunication platforms for intra and inter-organisational connection. Zoom became the dominant platform as organisations and individuals could no longer meet face to face. Video communication tools changed how stakeholders connect, providing a new context for how actors build and deploy relational capabilities. Video communication has also enabled 'easier' access to information in the ecosystem. With many conferences being shifted to online and recorded, people can now access information on their own terms. Participants believed this to be a positive thing that will improve collaboration and knowledge flows within the ecosystem.

> *"Seminar series that are now done online and everybody can participate and they can view it later means that we're a whole lot more inclusive about letting people know what other people are working on. And I think that will give more chance for collaborations and things as you, you've got much more of that communication. It's shortened the distance for our collaborations with people around the world…So I think*

*that may improve our whole collaboration space and make it easier for New Zealand to exist in that world." –Research institute 1*

Digitalisation has been rapidly institutionalised across the ecosystem in response to COVID-19. The adoption of digital platforms is reflective of an institutional change whereby digital platforms are set to persist in the 'now normal' environment. COVID-19 has imposed a need for organisations to engage in digital transformation as a matter of organisational resilience. In addition to using their capabilities to 'bounce back' from disruption, organisations can use their capabilities to create value through the way in which they engage with digital platforms.

Technical capabilities have allowed providers to remain resilient to supply chain challenges caused by COVID-19. Supply chain challenges have created upstream challenges as providers could not get raw materials or componentry into NZ to produce their offering. As a result, organisations had to create new components to overcome these upstream challenges. These organisations have created new or improved existing products by overcoming challenges, thereby extracting more value from these workarounds and developing their technical capabilities. This has also enhanced organisational resilience to current and future supply chain constraints.

*"Yeah, I mean it's like that forced innovation. You know where you, its yeah, you're innovating from necessity. Which is… The downside to that is, it adds other work because you've got it, especially in PLC programming we do a whole lot of preformed blocks. So, if I use the same device again, I don't have to rewrite code. But if you use a new device, I now spend to day to write the code. However, going forward that's done. I can just, you know, roll it out again. So, there is a balance to that, but it's um yeah. If anything, it's probably come de-risking our operation." –Agritech Startup 2*

COVID-19 has also reinforced existing challenges, increasing the pressures on organisations to innovate to ensure their resilience. As current ways of working have threatened organisational resilience, decision makers have had to consider the need to innovate to enhance their resilience.

Using automated based solutions to overcome labour challenges has been a significant source of tension within the ecosystem. Prior to COVID-19, agritech providers needed investment in market-shaping capabilities to drive the adoption of automated solutions. Many

primary producers were hesitant to invest in 'risky' automation technologies. This tension has constrained automation based innovation within the ecosystem.

The COVID-19 pandemic has enhanced the labour shortage pressure on the industry. The increased pressure has pushed producers to a point where they need to innovate to ensure their ongoing resilience. This has happened for several reasons:

1) Border closures have compounded labour shortages, meaning organisations can no longer make do; many a crop has gone to waste, impacting the bottom line of agriculture producers.

2) Worker constraints mean that most labour is focused on non-value-add activities.

3) With an increased demand for a finite labour pool, the cost of such labour supply has increased, thereby adding to the ongoing organisational costs.

> *"So yeah, from that respect. So yeah, coming back to that perspective, that's the good side of COVID is that people have actually gone crap, we can't just keep doing the old thing." –Agritech startup 2*

With border restrictions creating structural changes to labour availability amidst other challenges, current labour institutions are no longer appropriate. This creates incentives to develop and adopt solutions to address the problem, accelerating the demand for automation in production and processing activities. In this sense, the capabilities deployed for future resilience enable innovation to occur. This allows technology providers to respond accordingly and provide solutions that meet the needs of agriculture producers. While farmers are evaluating the role of technology in their strategic future, path dependencies and technological complexity mean that agritech innovation pipelines may take some time to catch up (KPMG, 2020).

### 4.5.2 Value creation enables resilience in changing environments

Findings show that innovation and resilience capabilities can reinforce each other where value creation is required to ensure resilience during and after a disruption. Despite the widespread disruptions, the respondents who identified as technology providers continued with their innovative activities during the crisis. According to managers and decision-makers of these organisations, the decision to continue with their innovative activities was in line with

their long-term vision and the ability to keep creating value for customers. Furthermore, their ability to create value keeps them relevant in the market and ensures their long-term survival.

> *"You know, the only thing that keeps us alive is that we can bring a solution to market faster than anybody out there, and that it's better or fills a gap or things like that. I mean, if we lose that ability to actually recognize and deliver what the industries need." –Agritech startup 3*

The ability to continue innovating despite the disruption is particularly relevant in a startup with limited resources and is inherent to its survivability. Startup organisations and other tech providers realised that their response to the pandemic would determine the future outlook of their business. Cognitive capabilities allowed these organisations to sense the changes in their immediate environment and envisage a future environment where their innovation would create value. 'Hunkering down' and riding out the storm was not an option for organisations. For these organisations, riding out the COVID storm without progressing their innovation agenda would mean losing momentum on projects, losing market share, and even risk failure of the organisation. As a result, their activities during the crisis were towards continued innovation and positioning themselves better in the market. This was also reinforced by the personal resilience of decision-makers and employees who persevered with disrupted working conditions.

> *"We just launched Proprietary Technology and if we, if we didn't do something, we were gonna, it was gonna die pretty rapidly or it was gonna be very very hard to get things going again. And look, a lot of that was pivoting to digital marketing to you know, a lot more zooms, lining up zoom calls, connecting, cold calling people, just a lot of that." –Agritech Incumbent*

The COVID-19 crisis has introduced many mass-market changes that have changed the institutional environment in which organisations operate. MBIE (2020) has identified key consumer trends that are changing the landscape of the agriculture ecosystem. Increased attention toward safety, convenience, traceability and provenance, environmental impact and health status of foods is key to the changing landscape (MBIE, 2020). In addition to this, there is an increased preference for value-added products and experiences surrounding food and beverages. Non-consumer-driven trends relate to geopolitical volatility, labour supply, workforce demographics, and climate change (KPMG, 2021; MBIE, 2020). Many of these

trends were identified before COVID-19 and have accelerated as the world focuses on global food security and other relevant issues (MBIE, 2020).

Because of this, innovation opportunities are becoming market led as actors are making sense of their new environment. Agritech is poised to address innovation opportunities through facilitating product differentiation and providing new solutions. Market orientation is key for innovation and resilience as organisations adapt to new operating environments and respond to market and institutional changes. Furthermore, the combination of market and technical capabilities will enable organisations to orchestrate their resources and create value that will keep them relevant amongst changing institutional environments, which is inherent to organisational resilience.

> *"And, I think probably the other key stand out for me is I think what it's done is it's heightened consumer awareness of issues that are important to them. So I think you know things like the environment, are no longer things that can be ignored because they are, the consumers are going to be much more activist, I think coming out of this." –Agribusiness advisor 1*

### 4.5.3 Innovation can be a preparedness capability for future disruption

Innovation can also be utilised as a preparedness capability to enhance resilience during future disruptions. Findings have shown that innovative activities can facilitate the development of products that purposefully or accidentally mitigate the impacts of environmental disruptions. This example was reflected in the pip fruit industry, whereby previous cultivar innovation for achieving market access and improving apple storageability has allowed the industry to enhance its resilience as supply chains have been disrupted.

> *"So, we've developed systems that we can use both low agrochemical inputs and also manage our pest and disease so we can get into Asia. Which gives us real flexibility and ability to move our product into different markets, depending on where the supply and demand is. And so that's innovation in our systems to develop that over time with our R&D." –Industry body 1*

Technological innovation is also perceived to be the key to enhancing the resilience of the agriculture ecosystem. Building technological capabilities within the ecosystem can help the industry overcome current challenges and prepare for future challenges and disruptions that

may threaten the ecosystem. This way, innovation can contribute to organisational resilience and a resilient ecosystem.

> *"And you know what, you know, so what's the role of automation? Which is not a switch, and it's not an overnight fix to labour issues, but it has a contribution to the ongoing evolution of the resilience of the sector." –Industry body 2*

The agriculture ecosystem in NZ faces several imminent crises that are not a result of the pandemic. The issues caused by these crises will likely supersede the impacts of COVID-19. Locally, the ecosystem faces capacity constraints in labour, land and water (New Zealand Productivity Commission, 2021a). Static prices of products and rising costs due to constraints risk placing organisations into a commodity trap that threatens significant economic disruption (New Zealand Productivity Commission, 2021a). The best example of capacity constraints is within the wine industry. Marlborough is facing capacity constraints in commercially suitable land for grape growing. The NZ wine industry relies heavily on production from the Marlborough region. Hence, this issue could also pose more general risks for the wine industry (New Zealand Productivity Commission, 2021a). This highlights a need for organisations to focus on growth and innovation through value-added products and continuous improvements to production and supply chains to remain resilient to potential economic disruption.

The agriculture ecosystem also faces disruption from global risks. The World Economic Forum 2022 global risks report ranks "climate action failure, extreme weather, and biodiversity loss as the top three most severe risks" (World Economic Forum, 2022). These risks are likely to have the most significant impacts on the agriculture ecosystem. Developing new products, processes, and technologies can reduce the food system's vulnerability to future disruptions and enhance the resilience of the ecosystem. Furthermore, innovation aimed at slowing the timeline of climate change can give organisations time to develop capabilities to prepare for the disruption. There is a global demand for sustainable innovation, driven by the need to develop or adopt innovations to enhance food system resilience. Whilst these disruptions are not on the immediate short-term horizon for NZ organisations, action taken now can better prepare the ecosystem for the disruptions to come.

### 4.5.4 Relational capabilities can facilitate the exchange of resources

Findings show that relational capabilities are critical to both innovation and resilience within the agriculture ecosystem. Relational capabilities facilitate the collaborative relationships and networks in which organisations participate. Collaboration across the ecosystem enables organisations to leverage collective R&D, market insights and marketing campaigns that have a collective global focus rather than focus on domestic competition (Agritech NZ, 2020). Furthermore, collaboration enables resource sharing, enabling organisations to overcome industry challenges and disruptions collectively. Relational capabilities enable organisations to interact with other actors and govern the terms of resource exchange within the ecosystem. Empirical evidence suggests that relational capabilities are integral for innovation and ecosystem resilience. However, they were not referenced in the context of organisational resilience.

Empirical evidence highlights that relational capabilities were considered essential for innovation, particularly from the R&D and commercialisation perspectives of smaller provider organisations. Relational capabilities allow providers to access support networks and external capabilities that allow organisations to advance their innovations. Providers can also use their relational capabilities to facilitate the validation of their innovation, leading to enhanced credibility and adoption potential. This allows organisations to focus on their areas of expertise and leverage their network's capabilities to create value. Innovation activities within startups and small organisations are integral to their success and developing capabilities that ensure their resilience. Consequently, relational capabilities are also imperative for resilience within these organisations.

> *"Any deep tech company should realize pretty early on you can't do what you're trying to do on your own. Uh, and if you can't secure VC funds or, or the right founding team. Or partner with all of our amazing CRI's on the tech that they have and the resources and the people in there. Then you know it's going to happen a lot more slowly. That's on the tech side." –Funder*

In addition to leveraging external capabilities for their own gain, organisational collaboration can create value by developing platform products or 'turn key' solutions that address multiple pain points on the value chain. Provider organisations recognised the need to develop products with the customer in focus. Collaborating to provide added value to customers can help adopter organisations see the value potential within innovations.

Consequently, they may be more open to adopting the innovation, allowing the ecosystem to somewhat shift in the preferred direction. Relational capabilities are facilitated by a shared vision that helps drive collective action. Where views are opposing, relationships are harder to develop between actors which support competing institutional paradigms. Nonetheless, relational capabilities deployed by actors can facilitate the connection between actors that drives discussion in the preferred direction.

> *"We're kind of all got a, which is one of the things we get along, I suppose, is that we've got a very similar outcome of the future, is about how we collaborate, not how we you know, we can't own a market. We need to work with everyone else to make sure we all have the best interest for the customer." –Agritech startup 2*

Relational capabilities can also serve a strategic benefit to producer organisations regarding technological innovation. From a producer perspective, relational capabilities allow these organisations to access technology that can enhance value creation and resilience within the organisation. Furthermore, where producer organisations choose to collaborate closely with provider organisations, they have the potential to articulate their needs and shape the technology to create additional value. The bidirectional feedback mechanisms between innovator and adopter can be enhanced by deploying relational capabilities that lead to developing innovations that can create more value for the ecosystem.

> *Yeah, I mean, we've partnered up with them. They are the supplier and designer and of the vehicles. We're the customer but we've worked really closely from the get go. So, we got on board with them before they'd built anything and worked through the whole concept and the functionality that was required and how that was going to work." – Large agriculture producer 1*

Shared challenges can provide a context in which relational capabilities are activated. The empirical findings show that organisations facing shared challenges will often share resources to respond to challenges collectively. As mentioned throughout this thesis, the challenges introduced by COVID-19 have been unparalleled and have not been restricted to individual organisations. Where organisations or industries are collectively disrupted, the ability to come together and overcome the challenges is critical to ensuring ecosystem resilience.

> *"You know, sort of the shared. The shared challenge of; OK, we're surrounded everything's gone to hell, let's get together and find a problem or find a solution to that.*

*That has definitely enabled different types of team dynamics and different types to productivity. And that's great. But you can't you know, and hopefully there's lessons out of that of what's possible when you pull everybody together." –Industry body 2*

Furthermore, where innovation is needed to address future challenges, relational capabilities will be critical to ensuring industry resilience. Organisations within the ecosystem will need to deploy their capabilities to engage in collaboration, innovation, and resilience to future imminent disruptions.

## 4.6 Broader institutional environment can enable innovation

### 4.6.1 Ecosystem can connect parties and help manage expectations

The supporting ecosystem can facilitate organisations' connectivity with local and global actors and help manage divergent expectations. Ecosystem connection was referred to more regarding innovation within the ecosystem rather than resilience. Apart from producers and providers, key entities in the ecosystem include: industry bodies, the government, Callaghan Innovation, funding organisations, research Institutes and advisory services. These entities provide key activities in connecting and guiding the ecosystem and teaching capabilities to organisations.

*"So that's what we would like to say like growing the pie. And so, building capabilities and adding more connections to the to the industry." –Funder*

Agritech innovators recognise the value of engaging with the industry and being customer-focused in their offerings. Participants agreed that the key factor in agriculture-based innovation is responding to an inherent need or problem in the industry. Industry input allows innovators to find a need to respond to that allows innovation to create value for the industry. Furthermore, when an innovator has a prototype or proof of concept model, getting industry feedback and validation will allow innovators to develop relationships with potential adopters and make the innovation acceptable for adoption, which is particularly important with high tech innovations such as automation.

Industry bodies in NZ are levy-funded organisations that represent and advocate for the needs of their associated industry. They can also engage in innovative activities that aim to create value for the entire industry. Industry bodies play a vital role by connecting their industry representatives with other ecosystem actors and with global opportunities.

> *"But that said those industry bodies have a huge, huge part to play in promoting technology and in doing some of the core fundamental research as well. And being the voice of the industry, you know." –Agritech startup 3*

Industry bodies can also facilitate communication between ecosystem stakeholders. A big challenge within the agriculture industry is navigating tensions between producers and providers around the perceived need for technologies. Communication between producers and providers is viewed as a key activity for managing expectations and providing solutions to create value for the producers. As industry bodies have a deep knowledge of their industry's problems and needs, they can articulate the needs of the industry to providers as well as communicate the challenges faced by provider organisations.

> *"So we just met up with Apple Pears the other day. I've dealt with them off and on over the years, but now we're sitting down saying: "hey, actually, this is what we need to achieve. How can you guys help us and you know we need a group of growers to get together and actually talk about what's the future, what's the problems and and let us talk about what our problems are as a solution provider… We need, like they need to be aware that we're having just as much issue as they are." –Agritech startup 2*

As well as this, industry bodies engage with the government on behalf of the industry. This can help facilitate change in the institutional environment and communicate the needs and challenges of industry to the government. One of the pertinent examples is the agritech industry transformation plan which aims to facilitate agritech innovation. Another example of industry body advocation to the government was seen during COVID, where industry bodies were advocating with the government to access key talent overseas for the organisations they represent.

> *"We've had some very engaging, very good engagement with government agencies to the point of co-developing a national strategy for the Agri tech sector, which is the first time that the government had really looked at Agri tech as a sector in and of itself." –Industry body 2*

### 4.6.2 The role of the government

The government plays multiple roles within the agriculture ecosystem. Agriculture as a primary industry plays a vital functional and economic role within society. Consequently, agriculture is a key strategic focus area for food system resilience and value-added products. The government can play a role in setting the institutional environment and facilitating the development of capabilities within the ecosystem.

Policy programs introduced by the government have an important role in guiding the ecosystem. The Agritech industry transformation plan (ITP), constructed in 2019/2020, was introduced as a blueprint to drive growth in the agritech sector through R&D, regulation, global opportunities, education, and talent (KPMG, 2021). In response to COVID-19, further policy programs were aimed at reinvigorating the ecosystem and responding to global innovation opportunities. The Fit for a Better World, reworked Agritech ITP and Horticulture Post COVID Recovery Strategy were introduced to address key industry needs and opportunities and facilitate positive change (Agritech NZ, 2020). Whilst the policy programs are well intended, there also needs to be an emphasis on implementation and support required to reduce barriers to achieving the industry vision (Agritech NZ, 2020). This comes through active communication with innovators to consider innovation challenges in top-down approaches and providing the necessary resources to facilitate the industry vision (Agritech NZ, 2020). The convergence of policy, investment and collective stakeholder action is set to drive innovation and support changes (Agritech NZ, 2020).

The government directly influences the ecosystem through funding into research and development programs. MBIE and Callaghan Innovation grants are a vital source of funding for many organisations. Furthermore, Crown research institutes are government-funded agencies with the ethos of creating value for NZ. Many respondents mentioned that government R&D spending was not at a level for NZ to be a global leader in agritech innovation. Furthermore, findings show that industry stakeholders find it challenging to access government programs as they are cluttered and confusing, with both gaps and duplication (New Zealand Productivity Commission, 2021a).

> *"So, we've got some really talented people and some great ideas, but we are completely underfunded in R&D in New Zealand. Like our government GDP spend on R&D is well below OECD average. So, we do do well with the funding that we've got. But we don't get that much R&D funding" –Agribusiness advisor 2*

The government also controls the regulatory environment, which can introduce innovation pressures or facilitate innovation development and commercialisation of innovation. The regulatory environment can force innovation to emerge as organisations need to comply with the imposed requirements. When innovations come about, the government can also change the regulatory environment to enable these innovations to thrive in the ecosystem.

> *"From a technology perspective, again, it's some of these things come down to also legislations. So, for example, I had a conversation a few years ago with a horticultural consultant and we were talking about measuring metrics for water usage. And he said he's had growers in NZ who have said; Why would I need to do that? We've got enough water here, you know. Why would I need to adopt sustainability processes when we have enough land, we have enough water, have enough sunshine, it's fine." –Agritech incumbent*

### 4.6.3 Organisational size determines the capacity for innovation

Findings have shown that the size of an organisation can determine its capacity for innovation. There is a significant disparity in innovation capacity across the ecosystem based on organisational size. The NZ Agri ecosystem producers consist of large and small organisations that occupy either single or multiple points across the value chain. Large organisations like Zespri or Turners and Growers represent a large proportion of their respective industries and control significant portions of their value chain. Other smaller organisations control either single or multiple activities on the value chain. The financial capability of larger organisations gives them a greater capacity to invest in innovation. Furthermore, they articulate most of the needs and challenges for providers to solve. This can mean the needs of smaller producers that do not have the investment capacity to invest in innovation are often forgone. This can limit the adoptability of technology in smaller producers.

> *"If your market that certain industry and you come in and you work with one of the bigger players in that industry, you're gonna be 90% there, right. You're going to have some differences, and so I think it's smart rather than just trying to, trying to determine what's needed." –Large agriculture 1*

> "*And there is certainly for areas like Marlborough and Hawkes Bay, a lot of those technologies are available to them that would reduce your labour massively. But again, that's something that Waiheke can't really capitalize on." –Small agriculture*

Zespri is a frontier firm and leader in innovation within the New Zealand agriculture ecosystem (New Zealand Productivity Commission, 2021a). Zespri is a large incumbent organisation that operates under a cooperative model and covers a broad scope of the kiwifruit value chain. It underpins many roles that large organisations would play in industry clusters by generating and protecting industry assets and acting as an anchor for its growers and supporting firms (New Zealand Productivity Commission, 2021a). Zespri needs to maintain an innovative agenda to maintain its reputation as a global frontier firm for kiwifruit.

Zespri is a leader in innovation due to the virtuous innovation cycle that is embedded in the Zespri operating model (New Zealand Productivity Commission, 2021a). The approach Zespri takes to innovation is characterised by long strategic horizons and a strong customer focus (New Zealand Productivity Commission, 2021a). Furthermore, key partnerships such as the longstanding relationship with Plant and Food Research support the translation and transfer of knowledge within the organisation (New Zealand Productivity Commission, 2021a). The collective operating model means that growers must comply with Zespri methods of orchard management. This allows the diffusion of new ideas to occur rapidly throughout the network. Zespri looks to create value by developing unique IP cultivars and licensing them to offshore growers to sell under the Zespri name. Locally, Zespri is seen as a critical target for agritech providers as the validation of technology by a large incumbent is integral to their technology's successful commercialisation. Participants agreed that Zespri is a bit of an anomaly when it comes to innovation within the ecosystem. Many participants also believed that Zespri's operation should set an example for innovation within the ecosystem.

> *"I suppose is the difference between Zespri and apples and pears. Is Zespri is funded. It like it, it's a control system, it's funded by the growers and the pack houses and everybody. And their sole purpose is to push and grow the market and, and get out there. And like Zespri does everything for the you know. They do all the overseas marketing and access channels and just, it's all sorted by them. Whereas Apple and Pear groups, each pack house or there's a few that sort of group together. They have to do it themselves. So, that's why I say Zespri is a bit of an anomaly because of what they are and how they operate. They, that's the business model I reckon, you know that a lot of these other guys should be doing. But they don't." –Agritech startup 2*

# Chapter 5: Discussion

This section discusses the findings of this study and how they confirm and extend the existing literature on systemic innovation and resilience. This allows the researcher to answer the research question according to the empirical findings.

*What are the tensions between innovation and resilience in service ecosystems?*

In order to answer the research question, this section also addresses the following sub-questions.

- *How do resilience and innovation capabilities in the agriculture ecosystem balance themselves out/hinder each other?*
- *How do innovation and resilience capabilities in the agriculture industry reinforce each other?*
- *How does an ecosystemic perspective provide enabling and disabling structures that support the reconciliation of innovation and resilience capabilities?*

## 5.1 Innovation and resilience hinder each other

The findings show that some of the tensions behind innovation and resilience may lie in the characterisation of these activities in the literature. There is a great deal of conflict in the literature between the capabilities, activities and outcomes that confer innovation and resilience. The findings of this study reflect blurred lines between the capabilities, purposes and outcomes of both innovation and resilience– they are both organisation specific and context-dependent. Further, capabilities are difficult to quantify due to the incorporation of so many overlapping activities (Teece, 2020). Consequently, interactions between innovation and resilience depend on the perspectives of actors and the context in which interactions are observed. For example, the findings show that some organisations believe themselves to be innovative when investing in endowments to create slack. Williams et al. (2017) describes this as investing in preparedness capabilities for resilience. Further, Ferher and Bove (2022) illustrate transformation and value creation as crucial activities for resilience when responding

to disruption. The findings deepen the understanding of the interactions between innovation and resilience by revealing some of the evident tensions within the agriculture ecosystem.

The findings show that preparedness capabilities present a source of tension with innovation. Preparedness capabilities can provide organisations with the necessary resources and capabilities to avoid threats or navigate disruptions (Fehrer & Bove, 2022; Linnenluecke, 2017). The findings extend on this by showing that preparedness capabilities can also reduce the need for organisations to innovate. Primary producers are often exposed to nature-related uncertainties that arise from land-based activities. Consequently, there is a need for the investment in capabilities that allow them to make do with the resources on hand. The preparedness capabilities built by organisations can reduce the sensitivity of organisations to changes in their environment, thereby reducing the need to invest in innovation where there is no perceived need. Further, the findings confirm that investments in specialised capabilities or investments to create slack can promote rigid decision making, organisational rigidity and commit the organisation to path dependencies (Teece 2016; Williams et al., 2017). Consequently, preparedness capabilities can not only hinder innovation, but also impede resilience if an organisation commits to a detrimental path.

The findings show that the temporal element of capabilities is also a key source of tension. This finding extends the current literature around cognitive capabilities for innovation and resilience. Teece (2016) describes cognitive capabilities as the knowledge, vision and values of key individuals within an organisation. Cognitive capabilities serve as the basis for strategic decisions for both innovation and resilience (Teece 2016; Williams et al., 2017). The findings show that the resilience of the agriculture ecosystem is driven by short-term thinking as producers plan around production cycles. The short-term vision of many organisations drives resilience but also promotes rigidity. The temporal element for capability deployment is not well discussed in the literature. This finding was reinforced during COVID-19 as the capabilities deployed to ensure short term resilience have constrained the ability to focus on long term innovation and opportunities. This finding reinforces what Williams et al. (2017) say about the dark side of resilience being a trade-off between resilience and value creation activities. Where organisations have a long-term focus, tensions can be somewhat resolved as change and adaptability can be inherent to long term resilience. This is as organisations envisage future environments beyond their immediate time horizons.

Through the lens of a service ecosystem, the findings reveal that the tensions between innovation and resilience in NZ agriculture predominantly arise from the overreliance on stabilising activities that do not allow the system to evolve (Fehrer and Bove, 2022). Whilst stabilising activities are necessary to maintain the equilibrium of the ecosystem, overusing stabilising tactics can introduce rigidity and limit the capacity for transformation (Gilly et al., 2014; Fehrer & Bove, 2022). The findings of this study confirm the above statement.

Comparing the resilience ecosystem framework with the innovation ecosystem framework portrays this finding in another light**.** Using the Chandler et al. (2019) framework as the pretext for this finding, the excessive use of stabilising tactics can negatively affect innovation. The findings show that the inherent resilience of the micro-elements (organisations) within the NZ agriculture ecosystem means that investments are directed toward maintaining the current institutional order (Chandler et al., 2019). If actors focus their institutional work on maintaining prevailing institutions, new ideas, and subsequently, innovation will not be able to emerge, limiting the transformative capacity of the ecosystem (Chandler et al., 2019; Fehrer & Bove, 2022; Normandin and Therrien, 2016).

## 5.2 Innovation and resilience reinforce each other

From the literature review, innovation is typically framed from the perspective of commercially beneficial outcomes and value creation (Geels, 2004; Teece 1997; Vargo et al., 2015). Consequently, the outcomes of innovation are growth, performance and economic advantage (Pisano and Teece, 2007). The findings of this study extend this perspective of innovation to include innovation as an integral element for resilience and ecosystem transformation.

The findings show that exposure to challenges in an ecosystem drives activities that confer both innovation and resilience. The literature explains that an essential capability for innovation is the combination of resources that allow organisations to provide solutions to present and future challenges (Adner and Kapoor, 2010; Vargo et al., 2015). The findings extend this by suggesting that capabilities deployed for resilience can help organisations overcome challenges and drive innovation. The NZ number 8 wire mentality is a prime example of the ability to overcome upstream innovation challenges as actors create novel ways

of solving problems. The ability to overcome challenges has been reinforced during COVID-19 as organisations needed to adapt their offering in response to supply chain constraints. NZ agriculture's lack of exposure to global innovation challenges can also explain the ability of environmental challenges to drive innovation. NZ agriculture has not been exposed to the same environmental challenges as its global counterparts. Consequently, NZ agriculture actors do not have the same innovation capabilities as those overseas. This points to leveraging global insights and addressing global challenges as key to boosting innovation within the agriculture ecosystem.

The COVID-19 crisis provides a unique context to observe some of the reinforcing interactions between innovation and resilience. This study reinforces the findings of (Heinonen & Strandvik, 2021), who demonstrate that innovation that has emerged out of COVID-19 reflects organisational specific responses to COVID that are embedded in the organisation's capabilities. COVID-19 has resulted in many 'imposed innovations' that are in line with either transient or permanent workarounds that have allowed organisations to continue operating during the pandemic. In further agreement with Heinonen and Strandvik (2021), innovations have not necessarily been novel, radical or disruptive. However, they reflect activities and actions deemed critical to the organisation's survival amongst the disruption. Technology exploitation has been a predominant feature in facilitating the 'contactless' working environment. Within this context, innovation and agility reflect a resilience capability that arises from the investment in generic and specific capabilities that increase disruption response (Boin & McConnell, 2007; Nenonen & Storbacka, 2020). Organisations can also look beyond the crisis and utilise their response to the disruption to create value going forward. Further, the crisis has also forced organisations to consider the tools and resources they need to remain resilient in the future.

The findings of this study show that value creation is integral for innovation and resilience. Within the literature, value creation is integral for innovation to embed itself in the ecosystem and drive institutional change (Vargo, 2015; Nenonen et al., 2019). The findings extend the importance of value creation, allowing organisations to remain relevant in changing market contexts. Heinonen & Strandvik (2021) emphasise the primacy of customers and market relevancy, which are essential factors in organisational resilience. Nenonen et al. (2019) links the primacy of customers to market orientation capabilities that allow the organisation to innovate in response to market needs. The findings reinforce that without customers and market

relevancy, the resilience of organisations can be hindered. This reinforces the importance of capabilities used during the response and adaptability phase of the crisis to adapt to immediate and the perceived future market needs.

Normandin and Therrien (2016) reinforce the importance of stabilising and destabilising activities in resilient ecosystems. The findings reinforce that ecosystem resilience is an emergent property that is dependent on the underlying activities that occur within the ecosystem. Within the perspective of the ecosystem, fluidity and stability, destabilising and stabilising activities are needed for ideas to emerge and converge as ecosystems adapt and evolve. More importantly, these activities are needed to maintain the resilience of the ecosystem. The COVID-19 disruption reflects an external influence on the ecosystem that has disrupted the dynamic equilibrium that comprises resilience. Consequently, organisations and other actors can engage in activities that promote transformation or stabilisation. Nonetheless, activities are focused on establishing a new equilibrium that will appeal to the craving for stability (Nenonen & Storbacka., 2020).

Using the Chandler et al. (2019) framework, this study can elaborate on how innovation and resilience can work together to advance the ecosystem in a setting characterised by disruption. The findings show that the COVID-19 pandemic has increased the plasticity of the ecosystem through physical and market impacts (for instance, border closures and restricted working environments vs changing consumer attitudes). Crisis events are characterised by a unique opportunity to shape ecosystems (Fehrer and Bove, 2022) as they create disrupted market systems which are more malleable and shapeable (Nenonen & Storbacka, 2020). The crisis has challenged actors' investments in the current institutional arrangements, creating institutional dissonance. Consequently, actors are faced with deploying their capabilities to either maintain institutional arrangements or invest in alternatives as they assess the suitability of their current investments. For instance, the compounded labour shortage drove agriculture producers to realise that the longstanding manual labour institutions are not viable going forward–as a result, producers are seeking out alternative options. This has presented agritech innovators with the opportunity to shape the ecosystem with offerings that reduce instability, create value and form new institutional arrangements.

## 5.3 How does the ecosystem reconcile the tensions

This study's findings reinforce the literature regarding the context-dependent building of capabilities. Both innovation and resilience capabilities arise from organisations' complex and dynamic interactions with their environment (Williams et al., 2017; Teece, 2007). The findings confirm that the environment in which an organisation is embedded provides access to contextual elements such as: social infrastructure, culture, skills, competitive environment, policies and market actors that provide the context for developing capabilities within the ecosystem (Lundvall, 2007; Geels, 2004). The NZ agriculture ecosystem and its lower-order ecosystems –for example, horticulture or even lower order systems such as wine and pip fruit– have different innovation patterns, drivers, and challenges. The historical relationship between organisations and their environment has created longstanding institutional arrangements and path dependencies that have placed NZ behind the global innovation frontier (Teece, 2020). Furthermore, the NZ agriculture ecosystem lacks many of the production challenges that international counterparts have to overcome. This means that NZ organisations have not had to innovate as rapidly to increase productivity.

The findings show that relational capabilities and ecosystemic collaboration are imperative to an innovative and resilient ecosystem. Furthermore, collaboration and communication between ecosystem actors are viewed as imperative to overcoming the tensions between innovation and resilience evident in the ecosystem. The findings reinforce that relational capabilities allow organisations to access resources to complement their resource base and collectively drive change (Teece, 2007; Aarikka-stenroos & Sandberg, 2012). Bouncken and Kraus (2013) stress the importance of coopetition within ecosystems. The findings reinforce this need and suggest that the NZ market is too small to have agritech providers compete against each other for a small customer pool. Instead, more value will be created through collaboration between providers to enhance the connectivity between existing solutions and create new solutions that allow them to compete on a global scale.

Etzkowitz and Leydesdorff (2000) stress the importance of the industry, academia, and government interaction in developing innovation and value creation (Geels, 2004). Whilst in an idealistic setting, it is clear that these interactions would be beneficial to increasing the value creation process, the findings of this study show that tensions exist within this triadic relationship in the NZ agriculture ecosystem. Currently, the ecosystem lacks the appropriate

talent and capabilities to engage in effective value creation. Further, academia lacks a sufficient understanding of the industry's problem and provides solutions embedded in technical and scientific superiority rather than value-creating solutions. This is reinforced by Lee et al. (2018). They suggest that an overreliance on scientific knowledge can lead to a disconnect between the proposed solutions and the needs of the technological market. There is also a seeming disconnect between academia and industry, whereby managing the expectations and needs of industry would allow for a better flow of ideas and value-creating solutions. Lastly, the government is needed for policy development, talent provision and R&D funding that guides the development and commercialisation of innovation within the ecosystem (Etzkowitz and Leydesdorff, 2000; Geels, 2004). Findings show that elements within the role are also lacking.

Other ecosystem actors are also integral for reconciling the tensions between innovation. The literature emphasises the importance of ecosystem actors within development and commercialisation networks that are of consequence to innovation (Aarikka-stenroos & Sandberg, 2012). The findings of this thesis draws upon certain actor groups that play a significant role in building capabilities and facilitating the exchange of knowledge and resources that facilitate the development and commercialisation of innovation. Industry bodies are one particular group that this thesis would like to draw attention to. While they can directly contribute to R&D and commercialisation activities, industry bodies have the potential to serve as an intermediary between industry organisations. The findings recognised that differing expectations between producer and provider groups create a source of tension that constrains value. The ability of actors such as industry bodies to provide a facilitating role to manage expectations and facilitate relational capabilities between other actors is integral to overcoming these tensions.

# Chapter 6: Conclusion

This chapter seeks to answer the research questions that this thesis posed. Furthermore, the conclusions of this study aim to provide solutions that organisations can use within the agriculture ecosystem to address the innovation problem and promote an innovative and resilient ecosystem. Lastly, this chapter provides suggestions for future research.

## 6.1 Answering the research questions

This thesis aimed to answer the following research question:

*What are the tensions between resilience and innovation in service ecosystems?*

In order to answer the research question, the research was structured into three main sub-questions to address the gaps identified.

1) *How do resilience and innovation capabilities in the agriculture ecosystem balance themselves out/hinder each other.*
2) *How do innovation and resilience capabilities in the agriculture ecosystem reinforce each other.*
3) *How does an ecosystemic perspective provide enabling and disabling structures support the reconciliation of innovation and resilience capabilities.*

In answering the first sub-question, the findings of this study identified five areas where resilience and innovation hinder each other. The first observation was that organisations' building of preparedness capabilities can reduce the need for organisations to innovate as they can make do with the resources on hand. The second observation is that the inherent focus of agriculture producers on production resilience can make them resistant to change, meaning that tech providers require capabilities to get producer organisations to see the value in adopting new technology. Further, the focus on production resilience of organisations can make them short term focused, which inhibits them from identifying long term opportunities. The third observation drew attention to the opportunity costs of investments. As organisations are faced with limited resources for strategic investment, the investment in capabilities for resilience can result in a trade-off for investment in innovation. Furthermore, financial capabilities are integral to the organisation's functioning, thereby, organisations need to preserve their financial capability, which can constrain the capacity for investment in innovation. The fourth

observation was a direct result of the COVID-19 pandemic. The ability to withstand the disruption and maintain positive functioning has driven short-term thinking and constrained the capacity of organisations to engage in strategic planning. Finally, the findings of this study showed that resilience capabilities can promote rigidity and failure to learn, which can compromise the organisation's resilience.

In answering the second sub-question, the findings showed that innovation and resilience can reinforce each other in many instances. The findings showed that organisations can engage in innovative activities to overcome challenges. This is one of the predominant ways that novel solutions arise in the NZ agriculture ecosystem. The findings also show that NZ agriculture lacks many environmental challenges that overseas counterparts face. Consequently, the lack of need to overcome said challenges has contributed to the ecosystem's innovation problem. Secondly, creating value is central to an organisation's resilience in changing market environments. Value creation recognises the primacy of the customer that the organisation exists to serve. The findings provide a more holistic interpretation of innovation, allowing organisations to create and capture value and promote resilience in changing environments. Lastly, relational capabilities serve as the underpinning for exchanging resources throughout the ecosystem that confer both innovation and resilience. Relational capabilities govern the dynamics of exchange and allow actors to form networks that support the development of capabilities. The findings recognise that collaboration is essential to value creation and the ability to overcome challenges and disruptions collectively.

In answering the third sub-question, it is clear that the ecosystem provides the context and interactions that support the development of capabilities. Findings have shown that the long history of the agriculture ecosystem has embedded institutional routines that inhibit innovation. Some prime examples include: the focus on domestic challenges, an academic driven innovation process, a culture of short-term thinking driven by an inherent focus on production resilience, and a lack of ambition for organisations to expand beyond the domestic horizon. Furthermore, the findings show that the tension between innovation and resilience is reinforced by the lack of supporting elements capabilities needed for value creation. The findings show that talent and funding access are key aspects of this issue. Furthermore, the findings demonstrate the potential for ecosystem participants to provide enabling structures that support both innovation and resilience.

The sub-questions answered in this thesis have allowed the researcher to answer the overarching research question. The findings have shown that there are some inherent tensions between innovation and resilience, which can be seen in the context of the agriculture ecosystem. Using the pretext of COVID-19 has provided further insights into how responding to the disruption has constrained the ability of organisations to engage in strategic activities. Whilst the tensions between innovation and resilience can be perceived as part of the innovation problem, there is a seeming lack of capabilities within the ecosystem to drive value creation and system transformation.

## 6.2 Theoretical contributions

This thesis makes several contributions to the existing literature. Firstly, this thesis explores the interactions between innovation and resilience within the context of a service ecosystem. This adds to the literature by drawing attention to instances where innovation and resilience hinder each other and reinforce each other, which is not well discussed in the extant literature. This study also extends upon the research on the dark side of resilience revealed by Williams et al. (2017).

The COVID-19 context utilised by this study adds to the literature by looking at innovation and resilience through a lens of disruption and environmental uncertainty. A limited amount of work provides insights into how long-term value creation can occur whilst actors face and recover from disruption. Consequently, this thesis adds to this gap in the literature and explains the temporal dynamics between innovation and resilience in a crisis context.

## 6.3 Practical Implications

This thesis has direct implications for actors within the agriculture ecosystem– particularly organisational decision-makers, policymakers, industry groups, and research organisations. Firstly, the findings of this study help to solve the practical problem that this thesis set out to answer: how the NZ agriculture ecosystem can be more innovative, and productive and how agritech can contribute to domestic productivity and the export economy of NZ. Understanding the tensions between innovation and resilience seeks to explain how the current institutional arrangements contribute to the innovation problem within the NZ agriculture ecosystem.

The findings show a need for organisations and actors to view innovation and resilience as long-term outcomes. This is also an inherent function of organisational purpose and vision. Vision and long-term strategy allow organisations to dedicate resources toward achieving their vision. However, at the same time, the vision also needs to be adaptable and flexible depending on the environment. Where organisations have a long-term focus, tensions between innovation and resilience can be somewhat resolved as change and adaptability can be inherent to long term resilience. This was also reinforced during the COVID-19 pandemic as short-term resilience actions constrained the long-term focus of organisations. Contrastingly, the focus on the long-term vision for some organisations during the crisis allowed them to engage in activities that allowed them to create value in future environments. Promoting long-term thinking within the agriculture ecosystem will also drive investment in innovation which is not governed by short term return on investment cycles. Instead, actors can invest with long term value creation in mind.

For developers of agritech innovation, this study shows a need to change how organisations innovate. The findings show that the current science-based innovation process tends to create point solutions that do not create value beyond their immediate purpose. Consequently, innovators need to consider other ways to develop innovation that creates broader value and, therefore, has greater potential to raise the innovation level in NZ Agriculture. Innovators need to consider the value that will be created from their innovation. Instead of focusing on point solutions, there is a need to focus on ‘turn key’ solutions that will address many issues along the value chain. Furthermore, the ability of innovators to look beyond their immediate customers and provide solutions that will also create value for other value chain participants is key to successful innovation. Successful innovation will be enabled through collaboration, communication, and consideration of the system-wide changes needed to create value for ecosystem actors. Lastly, the ability of innovators to create value in response to changing market contexts and leveraging global insights will be essential to reinforcing an innovative and resilient ecosystem.

This study's implications for government is the ability to articulate where the tensions between innovation and resilience lie within the ecosystem. The Government is an essential stakeholder in the primary sector and recognises the importance of the success of the primary sector to the NZ economy. This study recognises the government's importance in providing enabling structures that support innovation within the ecosystem. The findings suggest that

developing talent is central to overcoming the innovation problem. Furthermore, enabling structures that allow access to funding for agritech innovators. Lastly, strategic policy development can introduce pressures which force actors to see the need to innovate.

Lastly, this study shows that beyond the direct impacts of COVID-19, the crisis has brought forward a number of long-term issues that can no longer be ignored. Global connection and domestic collaboration is highlighted as being critical to addressing these challenges and ensuring the success of the NZ agriculture ecosystem.

## 6.4 Future Research

Given that there are many contextual nuances in the agriculture ecosystem, it would be interesting to investigate the interaction between innovation and resilience in other settings. This would test the generalisability of the tensions and complementarities between innovation with other settings.

There is still limited empirical evidence investigating the interactions between innovation and resilience, particularly within a crisis setting. Consequently, further research is needed to suggest how organisations can innovate to remain resilient during a crisis event and innovate to exploit and drive system transformation.

Lastly, it is evident that the effects of COVID-19 are persistent and long-lasting. Many interview participants believed that the emergent effects of COVID-19 are yet to reveal themselves. Follow up studies could investigate the impacts of COVID-19 over time and how this has affected the capabilities built by organisations. Further, at the time of writing this thesis, other crisis-level events have emerged, such as the war in Ukraine and severe weather events. Investigating how the effects of these crises have interacted and organisations have responded would be helpful in informing strategic engagement in a world that is becoming increasingly complex and uncertain.

# Appendix

## Appendix A: Interview schedule

### Interview Guide

Introduction

The aim of this project is to investigate the way in which organisations have innovated during the COVID 19 crisis. This study focuses on the agriculture ecosystem, which is set to lead the economic recovery for NZ. Innovation opportunities have been identified across the entire agriculture value chain, however, to what extent are these being exploited in times when organizations are dealing with the pressures of the COVID-19 pandemic? This study aims to provide managers with a strategic framework on how they can innovate in a crisis event, not only for survival but to create solutions that exploit new and emerging opportunities.

We are looking to develop a case study of the NZ agritech ecosystem. From this case, I aim to understand the capabilities that are possessed by organisations that allows them to engage in long term value creation.

**Introduction Interview Partner**

**Organisation:** What is the role of your organisation in the agriculture/agritech sector?

**Role:** How does your role relate to the agritech space?

**Personal Journey:** How has your role in the agritech space evolved?

**Checkpoint**

- Have capabilities for innovation/resilience been mentioned.
- Has COVID 19 and associated issues been mentioned.

**Innovation**

| | |
|---|---|
| **Type** | So tell me how innovation works in your organisation? |
| **Technological** | What does your organisation do in regards to technological innovation? |
| **Innovation Story** | What is the story behind your innovation activities? |

**Checkpoint**

- Have the strategic objectives of innovation been mentioned.
- Have workaround innovations been mentioned.
- Has collaboration in innovation been mentioned.

**COVID 19**

| | |
|---|---|
| **Impact on Organisation** | How has the COVID 19 pandemic affected your organisation? |
| **Impact on innovation** | How has COVID influenced the innovation process- Barriers and opportunities? |
| **Crisis management processes** | What has your organisation done in the past to prepare for disruptions? And how are you preparing for disruptions of the future? |

**Checkpoint**

- Have they talked about problems that need to be solved in response to COVID.
- Have they talked about improvisation and workarounds.

  No- What workarounds got implemented, how many of these are still in place.
- Have they talked about key activities.
- Have they talked about how their strategy has been impacted by COVID.

**Broader Service Ecosystem**

| | |
|---|---|
| **Innovation in the Ecosystem** | How does innovation work within your industry/ecosystem? |
| **Ecosystem During COVID 19** | What has the ecosystem done in response to COVID 19? |
| **Impacts of industry** | What takeaways does your organisation have from its collaboration? |
| **Collaboration on organisation** | with wider industry? |

**Checkpoint:**

- Have they talked about the role of government or industry bodies.
- Have they talked about knowledge sharing between ecosystem actors.
- Ways in which decisions are made between collaborators.

**SUMMARY**

- Are there any aspects of innovation during the COVID pandemic that you feel as though we have not discussed today?

- In summing up, what would you say are the 3 most important factors for the success of the NZ agritech innovation ecosystem?

# References


Aarikka-stenroos, L., & Lehtimäki, T. (2014). Industrial Marketing Management Commercializing a radical innovation : Probing the way to the market ☆. *Industrial Marketing Management*, *43*(8), 1372–1384. https://doi.org/10.1016/j.indmarman.2014.08.004

Aarikka-stenroos, L., & Sandberg, B. (2012). From new-product development to commercialization through networks. *Journal of Business Research*, *65*(2), 198–206. https://doi.org/10.1016/j.jbusres.2011.05.023

Aarikka-Stenroos, L., Sandberg, B., & Lehtimäki, T. (2014). Networks for the commercialization of innovations: A review of how divergent network actors contribute. *Industrial Marketing Management*, *43*(3), 365–381. https://doi.org/10.1016/j.indmarman.2013.12.005

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, *31*(3), 306–333. https://doi.org/10.1002/smj.821

Agritech NZ. (2020). *Aotearoa Agritech Unleashed*.

Baregheh, A., Rowley, J., & Sambrook, S. (2009). *Towards a multidisciplinary definition of innovation*. *47*(8), 1323–1339. https://doi.org/10.1108/00251740910984578

Bartlett, L., & Vavrus, F. (2016). *Rethinking Case Study Research*. Routledge. https://doi.org/10.4324/9781315674889

Boin, A., & McConnell, A. (2007). Preparing for Critical Infrastructure Breakdowns: The Limits of Crisis Management and the Need for Resilience. *Journal of Contingencies and Crisis Management*, *15*(1). https://doi.org/10.1111/j.1468-5973.2007.00504.x

Bouncken, R. B., & Kraus, S. (2013). Innovation in knowledge-intensive industries : The double-edged sword of coopetition. *Journal of Business Research*, *66*(10), 2060–2070. https://doi.org/10.1016/j.jbusres.2013.02.032

Calia, R. C., Guerrini, F. M., & Moura, G. L. (2007). *Innovation networks : From technological development to business model reconfiguration*. *27*, 426–432. https://doi.org/10.1016/j.technovation.2006.08.003

Carayannis, E. G., & Campbell, D. F. J. (2009). "Mode 3" and "Quadruple Helix": Toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management*, *46*(3–4), 201–234. https://doi.org/10.1504/ijtm.2009.023374

Chandler, J. D., Danatzis, I., Wernicke, C., Akaka, M. A., & Reynolds, D. (2019). How Does Innovation Emerge in a Service Ecosystem? *Journal of Service Research*, *22*(1), 75–89. https://doi.org/10.1177/1094670518797479

Chesbrough, H. (2020). To recover faster from Covid-19, open up: Managerial implications from an open innovation perspective. *Industrial Marketing Management*, *88*(April), 410–413. https://doi.org/10.1016/j.indmarman.2020.04.010

Crossan, M. M., & Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies*, *47*(6), 1154–1191. https://doi.org/10.1111/j.1467-6486.2009.00880.x

Dahesh, M. B., Tabarsa, G., Zandieh, M., & Hamidizadeh, M. (2020). Reviewing the intellectual structure and evolution of the innovation systems approach: A social network analysis. *Technology in Society*, *63*(September), 101399. https://doi.org/10.1016/j.techsoc.2020.101399

Edquist, C., & Hommen, L. (1999). Systems of innovation: Theory and policy for the demand side. *Technology in Society*, *21*(1), 63–79. https://doi.org/10.1016/S0160-791X(98)00037-2

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: Exploring the phenomenon. In *R and D Management* (Vol. 39, Issue 4, pp. 311–316). https://doi.org/10.1111/j.1467-9310.2009.00570.x

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From National Systems and "mode 2" to a Triple Helix of university-industry-government relations. *Research Policy*, *29*(2), 109–123. https://doi.org/10.1016/S0048-7333(99)00055-4

Fehrer, J. A., & Bove, L. L. (2022). Viewpoint: shaping resilient service ecosystems in times of crises – a trans-Tasman perspective. *Journal of Services Marketing*. https://doi.org/10.1108/jsm-06-2021-0216

Finsterwalder, J., & Kuppelwieser, V. G. (2020). Equilibrating resources and challenges during crises: a framework for service ecosystem well-being. *Journal of Service Management*, *31*(6), 1107–1129. https://doi.org/10.1108/JOSM-06-2020-0201

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). *Resilience Thinking: Integrating Resilience, Adaptability and Transformability*.

Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, *31*(3), 417–433. https://doi.org/10.1111/jpim.12105

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy*, *33*(6–7), 897–920. https://doi.org/10.1016/j.respol.2004.01.015

Gilly, J. P., Kechidi, M., & Talbot, D. (2014). Resilience of organisations and territories: The role of pivot firms. *European Management Journal*, *32*(4), 596–602. https://doi.org/10.1016/J.EMJ.2013.09.004

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods*, *16*(1), 15–31. https://doi.org/10.1177/1094428112452151

Gittell, J. H., Cameron, K., Lim, S., & Rivas, V. (2006). Relationships, Layoffs, and organizational resilience: Airline industry responses to september 11. *Journal of Applied Behavioral Science*, *42*(3), 300–329. https://doi.org/10.1177/0021886306286466

Godin, B. (2006). The Linear Model of Innovation The Historical Construction developed. *Institut National de La Recherche Scientifique*, *31*(6), 639–667. https://www.jstor.org/stable/29733964

Gomes, L. A. de V., Facin, A. L. F., Salerno, M. S., & Ikenami, R. K. (2018). Unpacking the innovation ecosystem construct: Evolution, gaps and trends. *Technological Forecasting and Social Change*, *136*, 30–48. https://doi.org/10.1016/j.techfore.2016.11.009

Gopalakrishnan, S., & Kovoor-Misra, S. (2021). Understanding the impact of the Covid-19 pandemic through the lens of innovation: *Https://Doi-Org.Ezproxy.Auckland.Ac.Nz/10.1177/23409444211013357*, *24*(3), 224–232. https://doi.org/10.1177/23409444211013357

Hansen, S.-O., & Wakonen, J. (1997). Innovation, a winning solution? *International Journal of Technology Management*, *13*(4), 345–358. https://doi.org/10.1504/IJTM.1997.001668

Heinonen, K., & Strandvik, T. (2021). Reframing service innovation: COVID-19 as a catalyst for imposed service innovation. *Journal of Service Management*, *32*(1), 101–112. https://doi.org/10.1108/JOSM-05-2020-0161

Hort NZ. (2020). *Horticulture Post Covid Recovery Strategy*.

Horticulture NZ. (2020). *NZ Grower- September 2020*. *75*(05).

Jiang, Y., Ritchie, B. W., & Verreynne, M.-L. (2019). Building tourism organizational resilience to crises and disasters: A dynamic capabilities view. *International Journal of Tourism Research*, *21*(6), 882–900. https://doi.org/10.1002/JTR.2312

Kabadayi, S., O'Connor, G. E., & Tuzovic, S. (2020). Viewpoint: The impact of coronavirus on service ecosystems as service mega-disruptions. *Journal of Services Marketing*, *34*(6), 809–817. https://doi.org/10.1108/JSM-03-2020-0090

Kafetzopoulos, D. (2020). Organizational ambidexterity: antecedents, performance and environmental uncertainty. *Business Process Management Journal*, *27*(3), 922–940. https://doi.org/10.1108/BPMJ-06-2020-0300

KPMG. (2020). *Agribusiness agenda 2020* (Issue June).

KPMG. (2021). *Agribusiness Agenda 2021: New Zealand, our customers, and our 2024 future*.

Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, *27*(2), 131–150. https://doi.org/10.1002/smj.507

Lee, C., Park, G., & Kang, J. (2018). and technology on innovation. *The Journal of Technology Transfer*, *43*(2), 522–544. https://doi.org/10.1007/s10961-016-9480-9

Lengnick-Hall, C. A., & Beck, T. E. (2005). Adaptive Fit Versus Robust Transformation: How Organizations Respond to Environmental Change. *Journal of Management*, *31*(5), 738–757. https://doi.org/10.1177/0149206305279367

Linnenluecke, M. K. (2017a). Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda. *International Journal of Management Reviews*, *19*(1), 4–30. https://doi.org/10.1111/ijmr.12076

Linnenluecke, M. K. (2017b). Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda. *International Journal of Management Reviews*, *19*(1), 4–30. https://doi.org/10.1111/IJMR.12076

Lundvall, B. Å. (2007). National innovation systems - Analytical concept and development tool. *Industry and Innovation*, *14*(1), 95–119. https://doi.org/10.1080/13662710601130863

MBIE. (2020). *Agritech Industry Transformation Plan* (Issue July, pp. 1–54). https://www.mbie.govt.nz/dmsdocument/11572-growing-innovative-industries-in-new-zealand-agritech-industry-transformation-plan-july-2020-pdf

Mohr, J. J., & Sarin, S. (2009). *Drucker ' s insights on market orientation and innovation : implications for emerging areas in high-technology marketing*. 85–96. https://doi.org/10.1007/s11747-008-0101-5

Moore, J. F. (1993). Predators and prey: a new ecology of competition. *Harvard Business Review*, *71*(3), 75–86.

MPI. (2020). *Fit for a Better World Accelerating our economic potential*.

Nenonen, S., Storbacka, K., & Windahl, C. (2019). Capabilities for market-shaping: triggering and facilitating increased value creation. *Journal of the Academy of Marketing Science*, *47*(4), 617–639. https://doi.org/10.1007/s11747-019-00643-z

Nenonen, S., & Storbacka, K. (2020). Don't adapt, shape! Use the crisis to shape your minimum viable system – And the wider market. *Industrial Marketing Management*, *88*, 265–271. https://doi.org/10.1016/J.INDMARMAN.2020.05.022

New Zealand Institute of Economic Research. (2020). *Could do better Migration and New Zealand's frontier firms NZIER report to the New Zealand Productivity Commission*. *November*. www.nzier.org.nz

New Zealand Productivity Commission. (2021a). *Frontier firms: Four industry case studies*. https://apo.org.au/sites/default/files/resource-files/2021-04/apo-nid311943.pdf

New Zealand Productivity Commission. (2021b). *New Zealand firms: Reaching for the frontier*.

Neyens, I., & Leuven, K. U. (2010). *The impact of continuous and discontinuous alliance strategies on startup innovation performance Dries Faems * Luc Sels*. *52*, 392–410.

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence Based Nursing*, *18*(2), 34–35. https://doi.org/10.1136/eb-2015-102054

Normandin, J.-M., & Therrien, M.-C. (2016). Resilience Factors Reconciled with Complexity: The Dynamics of Order and Disorder. *Journal of Contingencies and Crisis Management*, *24*(2), 107–118. https://doi.org/10.1111/1468-5973.12107

Öberg, C. (2019). The role of business networks for innovation. *Suma de Negocios*, *4*(2), 124–128. https://doi.org/10.1016/j.jik.2017.10.001

Partanen, J., Chetty, S. K., & Rajala, A. (2014). Innovation Types and Network Relationships. *Entrepreneurship Theory and Practice*, *38*(5), 1027–1055. https://doi.org/10.1111/j.1540-6520.2011.00474.x

Pisano, G., & Teece, D. (2007). How to Capture Value from Innovation: Shaping Intellectual Property and Industry Architecture. *California Management Review*, *50*(1), 278–296. https://doi.org/10.2307/41166428

Porter, M. E. (1985). *TECHNOLOGY AND COMPETITIVE ADVANTAGE*.

Sabahi, S., & Parast, M. M. (2019). Firm innovation and supply chain resilience: a dynamic capability perspective. *Https://Doi.Org/10.1080/13675567.2019.1683522*, *23*(3), 254–269. https://doi.org/10.1080/13675567.2019.1683522

Schumpeter, J. A. (1939). *Business cycles : a theoretical, historical, and statistical analysis of the capitalist process.* New York : McGraw-Hill 1939.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, *22*(2), 63–75.

Skålén, P., Gummerus, J., von Koskull, C., & Magnusson, P. R. (2015). Exploring value propositions and service innovation: a service-dominant logic study. *Journal of the Academy of Marketing Science*, *43*(2), 137–158. https://doi.org/10.1007/s11747-013-0365-2

Summit Dialogues. (n.d.). *New Zealand ' s Food System Pathway*. https://summitdialogues.org/

Teece, D. J. (1986a). *Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy*.

Teece, D. J. (1986b). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, *15*(6), 285–305. https://doi.org/10.1016/0048-7333(86)90027-2

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319–1350. https://doi.org/10.1002/smj.640

Teece, D., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review*, *58*(4), 13–35. https://doi.org/10.1525/cmr.2016.58.4.13

Teece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Therrien, M. C., Normandin, J. M., & Denis, J. L. (2017). Bridging complexity theory and resilience to develop surge capacity in health systems. *Journal of Health, Organisation and Management*, *31*(1), 96–109. https://doi.org/10.1108/JHOM-04-2016-0067

Timmermans, S., & Tavory, I. (2012). Theory Construction in Qualitative Research: From Grounded Theory to Abductive Analysis. *Http://Dx.Doi.Org/10.1177/0735275112457914*, *30*(3), 167–186. https://doi.org/10.1177/0735275112457914

TIN. (2020). *New Zealand Agritech Insights Report*.

Vargo, S. L., Akaka, M. A., & Wieland, H. (2020). Rethinking the process of diffusion in innovation: A service-ecosystems and institutional perspective. *Journal of Business Research*, *116*(February), 526–534. https://doi.org/10.1016/j.jbusres.2020.01.038

Vargo, S. L., Wieland, H., & Akaka, M. A. (2015). Innovation through institutionalization: A service ecosystems perspective. *Industrial Marketing Management*, *44*, 63–72. https://doi.org/10.1016/j.indmarman.2014.10.008

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. P. (2004). Resilience, Adaptability and Transformability in Social-ecological Systems. *Ecology and Society*, *9*(2). https://doi.org/10.5751/ES-00650-090205

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005). Organizing and the Process of Sensemaking. *Organization Science*, *16*(4), 409–421. https://doi.org/10.1287/ORSC.1050.0133)

Williams, T. A., Gruber, D. A., Sutcliffe, K. M., Shepherd, D. A., & Zhao, E. Y. (2017a). Organizational response to adversity: Fusing crisis management and resilience research streams. *Academy of Management Annals*, *11*(2), 733–769. https://doi.org/10.5465/annals.2015.0134

Williams, T. A., Gruber, D. A., Sutcliffe, K. M., Shepherd, D. A., & Zhao, E. Y. (2017b). Organizational response to adversity: Fusing crisis management and resilience research streams. *Academy of Management Annals*, *11*(2), 733–769. https://doi.org/10.5465/annals.2015.0134

World Economic Forum. (2022). *The Global Risks Report 2022*. https://www.weforum.org/reports/global-risks-report-2022

Yin, R. K. (2014). *Case study research : design and methods* (5 edition.). Los Angeles : SAGE. 2014.