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the Master thesis with the topic:

Governance Capacities for Climate Change Adaptation in New Zealand's Forestry Sector: Enablers, Constraints, and Mechanisms of Mobilisation

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Abstract

Although New Zealand's forestry sector is projected to experience adverse impacts from climate change, adaptation efforts have remained limited to date. In order to better understand the factors underlying this limited adaptation and to identify pathways to advance it, this research examines governance capacities, the factors shaping them, and the mechanisms through which they can be mobilised across multiple stakeholder groups. To gain an in-depth understanding of these processes, a policy analysis of 26 national adaptation policies and 40 semi-structured interviews with experts and key informants were conducted.

The results reveal limited consideration of forest adaptation within the analysed policy documents. Governance capacities vary both between and within stakeholder groups and are shaped by power relations, conflicts, competition and mistrust, institutional restructuring, limited interest and entrenched thinking, demographics, organisational flexibility, mutual understanding, and path-dependencies around the dominant management system. Key factors supporting the mobilisation of existing capacities into adaptation action include leadership, incentives, clear accountability, and the values and priorities of individuals able to mobilise capacities. Furthermore, the multilevel governance context can shape capacities, and either enable or constrain their mobilisation through supportive regulatory frameworks, and policy coherence and consistency across temporal and spatial scales.

The findings suggest that strengthening governance capacity alone is unlikely to be sufficient to accelerate adaptation. Rather, advancing adaptation requires not only enhancing governance capacities to establish enabling conditions across stakeholder groups, but also fostering the institutional, organisational, and leadership conditions that allow these capacities to be mobilised and translated into action. A more detailed understanding of these mobilisation mechanisms, beyond the assessment of capacities themselves, is needed to support transformative adaptation.

Keywords

Climate change adaptation, Forestry, Governance capacity, Capacity mobilisation, Multilevel governance, New Zealand

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Abbreviations

ANZBS	Aotearoa New Zealand Biodiversity Strategy
BTR	Biennial Transparency Report
CCC	Climate Change Commission
CCF	Continuous Cover Forestry
DOC	Department of Conservation
eNGO	Environmental Non-Governmental Organisations
ESG	Environmental, Social, and Governance
ETS	Emission Trading System
FAO	Food and Agriculture Organisation of the United Nations
FENZ	Fire Emergency New Zealand
FGR	Forest Growers Research
FOA	Forest Owners Association
ICNZ	Insurance Council of New Zealand
MfE	Ministry for the Environment
MPI	Ministry of Primary Industries
NAP	National Adaptation Plan
NBS	Nature-based solutions
NCCRA	National Climate Change Risk Assessment
NEMA	National Emergency Management Agency
NPSIB	National Policy Statement on Indigenous Biodiversity
NZ ETS	New Zealand's Emission Trading System
NZFFA	New Zealand Farm Forestry Association
NZIF	New Zealand Institute of Forestry
PA	Paris Agreement
PCE	Parliamentary Commission for the Environment
RMA	Resource Management Act
R&D	Research and Development
TUR	Te Uru Rākau
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

Accelerating climate change is already affecting forest ecosystems worldwide by altering their structural, species, and genetic diversity and disrupting ecosystem functioning (Fischlin et al. 2007, Marshet & Fekadu 2019, Parmesan et al. 2022, Lawrence et al. 2022). While rising atmospheric CO₂ concentrations may provide temporary benefits for forest productivity through CO₂ fertilisation, increasing evidence indicates that these benefits are constrained by declining CO₂ fertilisation effects, resource limitations, and intensifying climate change related disturbances (Wang et al. 2020, Sperlich et al. 2020). In addition, particularly in temperate regions, the pace of climate change, combined with the high fragmentation of forest ecosystems, is expected to exceed the natural adaptive capacity of many species by limiting natural migration and regeneration (FAO 2001, Fischlin et al. 2007). Consequently, there is growing consensus that active management and planned adaptation are required to enhance forest resilience under changing climatic conditions (Bernier & Schoene 2009, New Zealand Climate Change Centre 2010, Meason & Mason 2014, Marshet & Fekadu 2019, Hoeben et al. 2025). Despite this recognition, the implementation of forest adaptation measures remains unevenly distributed across regions, with Oceania identified as one of the least studied regions (Berrang-Ford et al. 2021, Fischer et al. 2024).

New Zealand provides a particularly relevant case for investigating this implementation gap. Its forestry sector plays an important role in the country's economy as the third-largest export sector, is a crucial provider for regional employment, particularly in rural areas, and constitutes an important component of New Zealand's heritage, possessing considerable spiritual value for the Māori population (Ministry for Primary Industries 2023). At the same time, New Zealand's forests are projected to face increasing climate change related disturbances, including more frequent and severe wildfires, storm damage, pest outbreaks, as well as the expansion of invasive tree and weed species (Dunningham et al. 2012, Watt et al. 2019, Cradock-Henry et al. 2019). Other challenges, particularly for the dominant plantation system of radiata pine (*Pinus radiata*) monocultures, include the spread of fungal pathogens such as *Dothistroma pini*, which can increase under warmer climate conditions and are estimated to cause significant financial losses (New Zealand Climate Change Centre 2010). While some of these impacts are already becoming evident, including the Pukaki and Ōhau wildfires in 2020 and the damage caused by Cyclone Gabrielle in 2023, adaptation efforts within New Zealand's forestry sector have remained comparatively limited (Villamor et al. 2022, Villamor et al. 2023a). Although climate change adaptation has received increasing political attention since 2017 through the introduction of national adaptation legislation, climate risk assessments, and national adaptation planning, it remains only weakly embedded in

New Zealand's forest policy landscape (Villamor et al. 2023b). This is further reflected in recent reductions in government spending on climate change adaptation (Forest & Bird 2025b).

Beyond the ecological and technical dimensions, climate change adaptation is widely recognised as a governance challenge because responsibilities for adaptation are typically distributed across multiple sectors, organisations, and administrative levels (Adger et al. 2005, Gupta et al. 2010, Pahl-Wostl 2009, New et al. 2022, Dilling et al. 2023). Effective adaptation depends on the ability of multiple stakeholders across sectors and administrative levels to coordinate, learn, make decisions, and implement appropriate responses under changing conditions (Folke et al. 2005, O'Brien et al. 2006, New et al. 2022). Therefore, analysing climate change adaptation through a governance lens enables a better understanding of societal processes, the creation and functioning of organisations, rules, as well as formal and informal institutions to guide adaptation (North 1991, Huiteima et al. 2016). While research on adaptive capacity has predominantly examined it through the sustainable livelihoods framework, focusing on financial, human, social, and physical assets, comparatively less attention has been paid to governance capacities and the governance processes that shape adaptation across multiple stakeholders and administrative levels (Fischer et al. 2024, Chapagain et al. 2025). Furthermore, although governance capacities are increasingly recognised as important antecedent conditions of adaptation, comparatively little is known about how these capacities are mobilised and translated into adaptation action (IPCC 2001, Burch 2010, Mortreux & Barnett 2017, Freduha et al. 2018).

This study addresses these gaps by examining the multilevel governance context and governance capacities for climate change adaptation across New Zealand's forestry sector, the factors shaping these capacities, and the conditions under which they are mobilised into adaptation action. Thereby, this study seeks to identify remaining policy gaps, constraints to governance capacities and their mobilisation, while contributing to a better understanding of how climate change adaptation can be enabled.

2 Theoretical framework

2.1 Climate change adaptation of forest ecosystems

Climate change adaptation of forest ecosystems may occur through autonomous ecological processes as well as through deliberate human interventions. In this study, adaptation refers to deliberate human responses that seek to reduce the adverse consequences of current or anticipated

climate change (IPCC 2022). Human interventions for forest adaptation can further be differentiated into infrastructural, institutional, and behavioural measures (Berrang-Ford et al. 2021). Infrastructural measures refer to technical solutions, equipment and facilities such as firebreaks, while behavioural measures can include management changes and the use of tree species better adapted to changing climatic conditions. Institutional adaptation measures may include the creation of policies, regulations and organisations (Berrang-Ford et al. 2021). This study further distinguishes between transformative and incremental adaptation. Incremental adaptation involves adjustments that seek to preserve the basic functioning of an existing system, whereas transformative adaptation refers to moving to a new system state (Engle 2011, IPCC 2022).

While adaptation is often discussed in terms of implemented measures, successful adaptation involves more than the actions themselves. It depends on the capacities that make adaptation potentially possible, the internal and external conditions that shape or enable their mobilisation, and the implementation of adaptation actions (Adger et al. 2005). Therefore, the climate change adaptation literature has highlighted that possessing the ability to adapt does not necessarily result in adaptation action (Freduha et al. 2018, IPCC 2022, Schubert et al. 2025). Accordingly, this study distinguishes analytically between governance capacity to adapt, the processes and conditions that shape this capacity, and the factors that constrain or enable its mobilisation. This distinction provides the conceptual foundation for the analytical framework developed in this study.

2.2 Adaptive capacity

The implementation of adaptation action depends on the available capacity of stakeholders as well as the effectiveness of governance and decision-making processes (IPCC 2022). Thus, adaptive capacity has become one of the central concepts in climate change adaptation research. The IPCC (2022) conceptualises adaptive capacity as the ability to adjust to climate change and to make use of opportunities that may arise from it. Adaptive capacity is widely understood as a multidimensional concept encompassing physical, human, financial, natural, and social capital, although definitions vary (Mortreux & Barnett 2017, Chapagain et al. 2025). Among the various dimensions of adaptive capacity, institutional and governance dimensions play a particularly important role because adaptation commonly involves collective decision-making across and within multiple organisations, sectors, and administrative levels (Adger et al. 2005, Engle 2011, IPCC 2022). However, governance dimensions have so far received limited attention in the literature (Chapagain et al. 2025). Therefore, and given the broad scope of the adaptive capacity concept, this study focuses specifically on the governance capacity to adapt to climate change.

2.3 Multilevel governance and governance capacity

In contrast to traditional notions of government, governance emphasises decision-making through self-organising networks that include non-state stakeholders interacting through collaborative arrangements and shared responsibilities rather than hierarchical state control alone (Rhodes 1996). Thus, governance refers to the processes, institutions, and interactions through which public and private stakeholders collectively address common challenges (Rhodes 1996). The term stakeholder refers here to an entity that has an interest in and is affected by a policy but, unlike actors, may not have the possibility to influence the policy (Schusser et al. 2016).

The concept of multilevel governance, referring to governance processes at all administrative levels as well as their dependence and interaction, has proven useful in analysing processes such as climate change adaptation that involve multiple stakeholders, levels, and networks (Bressers & Kuks 2003, Ishtiaque 2021). In this study, the multilevel governance context, adaptation policy frameworks and legislation are conceptualised as external structural conditions. These conditions can influence the opportunities available to stakeholders, define responsibilities, and may either enable or constrain governance capacities and their mobilisation (Adger et al. 2005).

To examine the institutional dimension of adaptive capacity, this study adopts governance capacity for climate change adaptation as its primary analytical lens. Governance capacity refers to the potential internal ability of stakeholders to address collective challenges through coordinated action (van Popering-Verkerk et al. 2022). Using the framework introduced by van Popering-Verkerk et al. (2022), governance capacity is conceptualised through five elements: (i) collective action, (ii) coordination, (iii) learning, (iv) resilience, and (v) resources. Following van Popering-Verkerk et al. (2022), this study conceptualises collective action as the interrelated actions of stakeholders and the extent to which their actions create or restrict opportunities for others. In contrast, coordination is operationalised through information exchange and collaboration, with collective action treated as a possible outcome rather than a necessary consequence of coordination. Learning is differentiated into cognitive, social, and institutional processes. Resilience concerns stakeholders' ability to respond to opportunities and threats, while resources encompass the material, financial, informational, human, and power-related assets available to stakeholders and their ability to manage these to perform governance functions (van Popering-Verkerk et al. 2022). These five elements provide the analytical categories for examining the existing governance capacity of different stakeholder groups in New Zealand's forestry sector and the factors shaping these capacities.

2.4 Mobilising governance capacity

This study distinguishes between existing governance capacities and the mechanisms through which these capacities are mobilised, since understanding adaptation requires moving beyond the assessment of governance capacity alone (Mortreux & Barnett 2017). While early research on adaptive capacity has predominantly focused on asset-based analysis, more recently research has identified a capacity-action gap in adaptation and has thus highlighted the need for understanding mechanisms that mobilise capacities (Nelson et al. 2007, Mortreux & Barnett 2017, Schubert et al. 2025). For the purpose of this study, mobilisation mechanisms of governance capacity are analytically distinguished into internal governance mechanisms and external institutional conditions. Internal governance mechanisms refer to processes operating within stakeholder organisations and governance networks, while external institutional conditions comprise the wider multilevel governance environment that can create opportunities and constraints for mobilising capacities by shaping the institutional context within which governance capacity is exercised (Engle 2011).

Taken together, governance capacity, factors shaping capacity, its mobilisation mechanisms, and the broader multilevel governance context provide the analytical framework for this study.

3 Research questions

In light of this theoretical background, the study strives to answer the following research question:

How is governance capacity for climate change adaptation shaped and mobilised across forestry stakeholders in New Zealand's forestry sector?

Sub-questions:

1. How does the multilevel governance context shape governance capacity for climate change adaptation?
2. How does governance capacity vary across forestry stakeholders, and what factors enable or constrain it?
3. How does governance capacity relate to observed climate change adaptation?

4 Methods

This study explores New Zealand's forestry sector as a case study to analyse stakeholders' governance capacity in relation to climate change adaptation across the national forestry system. Given the limited understanding of how governance capacities translate into adaptation action in New Zealand's forestry sector, an exploratory qualitative approach incorporating a policy analysis and qualitative interviews under a pragmatic paradigm was adopted (Creswell & Creswell 2018).

4.1 Data collection

4.1.1 Stakeholder mapping

In order to identify key stakeholders for the interviews and support the policy analysis, a stakeholder analysis was conducted (Grimble & Chan 1995, Varvasovszky & Brugha 2000). Secondary data, including published reports, policy documents, and public statements, were reviewed to identify relevant stakeholders (Appendix 1).

4.1.2 Policy documents

National policies addressing climate change adaptation, environmental adaptation, forestry, or climate-related hazards relevant to forests were identified in April 2026 through online searches and summary reports. Summary reports were consulted when referring to specific climate change adaptation measures and policies. For instance, New Zealand's first Biennial Transparency Report (BTR) submitted under the Paris Agreement includes an overview of national adaptation policies. Relevant policies mentioned in the report were thus reviewed (Ministry for the Environment 2024). All analysed policies are listed in Appendix 2.

4.1.3 Semi-structured interviews

Semi-structured interviews were chosen to explore stakeholders' perceptions and experiences in depth, given the exploratory research design. Using open-ended questions allowed participants to articulate their perspectives while enabling follow-up questions on emerging themes (Creswell & Creswell 2018).

Interview participants were identified through an iterative purposeful sampling process aimed at maximising the relevance and diversity of data in relation to the research questions (DiCicco-Bloom & Crabtree 2006). Recruitment involved snowball sampling, self-selection following a call for

participation in a farm forestry newsletter, and recruitment through personal networks and online searches. A total of 40 semi-structured interviews with 42 participants were conducted. Interviews ranged from 29 minutes to 2 hours and 14 minutes, with an average duration of 50 minutes. The number of interviews was considered sufficient to capture the main issues relevant to the research questions, as recurring themes had emerged and few substantially new issues were identified (Bernard 2006). Two of the interview participants provided written answers instead of a face-to-face interview. All other interviews were conducted either in person or by video call or telephone. Two of the in-person interviews also provided additional written statements. Interview participants included key informants and experts based on their expertise and stakeholder affiliation, including different forestry stakeholders, researchers and civil society representatives (see Table 1). To facilitate accurate transcription and analysis, all interviews were recorded if participants granted permission, which was the case for all but two interviews. The interview guides provided in Appendix 3 and 4 were used as the basis for the interviews and were adapted to reflect each stakeholder's expertise and background. The guide was based on previous findings on constraints to adaptation in New Zealand by Villamor et al. (2023a) and the Ministry for the Environment (2024) as well as a meta-analysis on adaptation barriers and opportunities by Oberlack (2017). Ethical clearance for the interview guides was provided by the TU Dresden prior to the interviews (Appendix 5). For Indigenous ethical considerations, the Māori Team at Scion was consulted (Arifin 2018, Creswell & Creswell 2018).

Table 1: Interview participant affiliation and interview identifier

Affiliation	Interview identifier
Research	R1 - R6
International Organisation	INT1
Government	GOV1
Regional and District Councils	C1 - C3
State Forestry Service – Te Uru Rākau (TUR)	TUR1 - TUR3
Forestry Industry (large-scale owners ≥ 1000 ha and forest management organisations)	FI1 - FI12
Smallholders, farm forestry (<1000 ha)	FF1 - FF7
Māori forest owners and consultants	MF1 - MF4
NGOs	NGO1 - NGO2
Forest investment managers	INV1

4.2 Data analysis

4.2.1 Stakeholder analysis

Building on Varvasovszky & Brugha (2000) and a framework presented in a course on Institutionalization of Forest Data provided by the FAO (2023), the following stakeholder characteristics were explored: Involvement in climate change adaptation, interest in it, power to influence adaptation, and their position in relation to it. As the stakeholder analysis was conducted primarily to inform the policy analysis and selection of interview participants, it is provided in Appendix 1.

4.2.2 Policy analysis

First, the policy content was analysed based on Hall (1993) and Capano & Howlett (2024), assessing the policy issue, aims, instruments (economic, cooperative, informational, or regulatory), and implementation provisions, including implementing actors, resources, institutional settings, monitoring, and administrative procedures (Digital Appendix 2). The policy issue was further categorised as issue-focused, addressing climate change adaptation of environmental systems as the primary issue; as related, addressing it as a secondary issue; or as relevant, not directly addressing it but having relevance for adaptation on the ground (Giessen et al. 2016). Within the set of policies identified and analysed in this study, no policy explicitly focused on forest adaptation. Therefore, broader environmental adaptation policies were analysed on the basis that they also encompass forest ecosystems. This analysis was supported by literature research.

Second, policy coherence was assessed with a focus on interactions between policy objectives using the framework of Nilsson et al. (2012; 2016). A screening matrix evaluated policy objectives horizontally, comparing issue-focused environmental climate change adaptation policy objectives with the objectives of analysed forest policies, and objectives within each policy field (Digital Appendix 3). Interactions were qualitatively assessed based on the extent to which policy objectives supported or constrained one another and were coded as indivisible (3), reinforcing (2), enabling (1), consistent (0), constraining (-1), counteracting (-2), or cancelling (-3) (Nilsson et al. 2016). The assignment of scores involved researcher judgement. Rather than conducting a stakeholder workshop as proposed by Nilsson et al. (2012), this study triangulated the findings with the interviews. This approach was considered appropriate given the study's focus on capturing diverse stakeholder perspectives, while a collective stakeholder workshop was beyond the scope of the study. The same process was applied vertically to climate change adaptation policies across

administrative levels for the case of the Bay of Plenty Regional Council and Rotorua Lakes Council (Digital Appendix 4).

4.2.3 Interview analysis

A system of categories was first developed inductively from the interview data to enable systematic analysis (Mayring 2015, Digital Appendix 1). After the initial coding and organisation of the data, the governance capacity framework of van Popering-Verkerk et al. (2022) was identified as a suitable framework for structuring and interpreting the emerging categories. The categories were subsequently organised under the five elements of governance capacity, alongside factors shaping these capacities and mechanisms through which they were mobilised into adaptation action. Factors were coded as capacity-shaping conditions when participants described them as affecting the availability or quality of a governance capacity. Factors were coded as mobilisation mechanisms when participants described existing capacities as being translated into concrete adaptation decisions or actions.

Interview codes cited in the results are illustrative rather than exhaustive. Where more than four interviews supported a finding, citations were limited to the first two, with the full set of supporting interviews provided in Appendix 6.

5 Results

5.1 The Governance capacity of New Zealand's forestry stakeholders

5.1.1 Collective action

Collective action was described as highly relevant for climate change adaptation of the forestry sector but as remaining limited (R1, FI11, FF2, FF5). Observed collective action included industry efforts to broaden its room for action through lobbying at the government level, which was, however, constrained by the absence of a joint lobbying strategy within the industry (FI7, FI8). Farm forestry organisations and environmental non-governmental organisations (eNGOs) created additional opportunities for collective action by helping to create markets for native and alternative exotic tree species that can subsequently be used by other stakeholders (FF4, INV1). Additionally, government initiatives supporting biodiversity projects with multiple industry partners, as well as

shared research projects, and strategic alignment with regional councils, facilitated collective action (INV1, FI1).

Nevertheless, conflicts between the forestry industry and regional councils, alongside the perception of regulatory entities' limited consideration of up-to-date science appeared to constrain stakeholders' room for action, particularly in regions exposed to climate change related risks such as Gisborne (C3, MF4). Competition within forestry was similarly seen by some as a constraint, although others viewed it as healthy economic competition (FI1, FI8, FI9, TUR2). In addition, the 1991 Forest Accord was perceived to reinforce a rigid separation of conservation and production objectives, limiting discussions on alternatives that do not fit neatly into either category (FI9, NGO1). Farm foresters further perceived that the forest industry has successfully shaped building standards in ways that favour *P. radiata*, thereby limiting market opportunities for alternative timber species and constraining the room for action of farm foresters (FF2–FF4). Finally, TUR's overlapping advisory functions were perceived to reduce parts of the industry's room for action (FI3).

Overall, collective action on adaptation remained limited and was primarily constrained by conflicting interests, unequal power relations, and fragmented institutional arrangements.

5.1.2 Coordination

Information exchange

Information exchange within stakeholder groups was generally well established through workshops, field days, action groups, and personal relationships, making exchange relatively low-threshold (FF6, MF2). Māori forest owners and advisors emphasised intergenerational knowledge sharing and specialised advisory organisations (MF2, MF3). However, limited communication between company managers and shareholders, geographic dispersion, and remote locations constrained exchange (FF2, FF3).

Within the sector, professional networks, industry conferences, Māori forestry groups, transition and catchment groups facilitated knowledge exchange, supported by intermediary organisations such as the New Zealand Farm Forestry Association (NZFFA), the Forest Owners Association (FOA), and eNGOs (NGO1, NGO2). However, conflicts with regional authorities and weak vertical integration constrained exchange in some cases (FI1, FI7, FI11, FF5).

Cross-sector exchange remained limited due to competition and silo structures, although some initial changes were observed (R1–R3, FF1). Farm forestry was considered well positioned to bridge forestry and agriculture through its involvement in both sectors (NGO1, FF2–FF4).

International exchange remained concentrated among English-speaking countries with similar clear-fell systems, although the Conference of the Parties (COP) and international markets increasingly exposed stakeholders to alternative approaches (TUR1, C2, FI1, FI5).

Overall, information channels were well established but remained fragmented around adaptation and predominantly focused on *P. radiata* (MF4, GOV1).

Collaboration

Participants generally described the forestry sector as collaborative, including with research organisations, local partners, fire services, Māori iwi (tribes), ports, sawmills, TUR, and eNGOs, and viewed the environmental committee of the FOA as an important catalyst for collaboration (FI2, FI5). However, collaboration on adaptation was often described as reactive and project-based rather than strategically coordinated (GOV1). Limited cross-sector planning and alignment, silo structures, differing client demands, and weak vertical integration further complicated collaboration (C1, R1).

Further constraints and enablers

Besides the mentioned constraints, mistrust emerged as a major challenge to coordination and collective action, particularly between the forestry industry and eNGOs, wider society, and regional authorities (NGO2, FI10, FI12, C1). Particularly in exposed regions such as Gisborne, industry participants perceived councils as unreceptive to industry solutions, and, in some cases, as seeking to exclude industry involvement, while mistrust towards councils among rural land users was likewise reported (FI1, FI3). Mistrust was additionally reported within the forestry sector and between forestry and agriculture, although some relationships were improving (FF2, FI3). However, positive relationships with councils and communities were also reported, particularly in regions with high forestry employment (FI2, FI11, R2, FF6).

5.1.3 Resilience

Dealing with opportunity

Participants identified several opportunities that could be explored to adapt forestry management in response to climate change. These included windows of opportunity arising during harvest and restocking cycles, such as changing species, as well as the salvage of timber following forest fires and windthrow events (FI6, FI8). Farm foresters further identified diversification as an opportunity

to reduce the risks associated with reliance on a single species (FF3). In exposed regions, participants also identified more creative management approaches as potential responses (FI1).

Overall, participants suggested that opportunities for adaptation frequently emerge following disturbances or during management transitions. However, the occurrence of opportunities did not necessarily translate into adaptation action, with maintaining the status quo remaining the predominant response to date (R1).

Constraints and enablers

Participants identified a need to address climate change through long-term, system-based approaches, yet adaptation in the forestry industry was widely characterised as reactive, with limited anticipatory planning (R1–R6). Conversely, farm foresters reported pursuing longer-term solutions, for instance through breeding programmes (FF2), while Māori forestry entities were viewed as comparatively proactive (NGO2). The predominantly reactive approach was attributed partly to the perception of New Zealand's comparatively low exposure to climate change impacts, which reduced the perceived urgency for anticipatory action, to economic pressures and recovery from previous extreme weather events, which constrained investment in proactive measures (R2, FF5). Similar constraints were identified among councils, where ongoing recovery efforts limited their capacity to engage proactively with the forestry sector (C2, C3).

Perceived institutional inertia, particularly within the forestry industry, was characterised by risk aversion and efforts to maintain existing business models through incremental rather than transformative adaptation (TUR1, FF2). The continued focus on improving *P. radiata* reflected this tendency, with the strong performance of existing systems, substantial investments in it, and associated switching costs perceived to reinforce path dependency (FF5, TUR1). Participants also reported limited interest in exploring alternative forestry systems, adaptation strategies, and knowledge beyond the dominant model (R2, FI8). In addition, participants identified a contradiction whereby the industry's risk aversion was perceived to constrain adaptation while simultaneously increasing its vulnerability to future climate risks (FF5). The observed incremental adaptation was consequently considered insufficient by some given accelerating climate impacts, while others viewed it as necessary to enable gradual change and avoid institutional lock-ins (GOV1, FF5).

Institutional inertia was closely related to perceived limited organisational flexibility within the forestry industry. Continued reliance on *P. radiata* and a focus on productivity and wood quality traits were seen to constrain flexibility, although greater attention to resilience traits has emerged recently (FF3, FI1). Long harvesting cycles, ownership structures, and market conditions were also perceived to limit agility, although some noted that New Zealand's *P. radiata* forestry has

comparatively short rotation lengths (R1, R2). Farm foresters were viewed as more flexible due to their smaller scale, different business models, and greater control over investment and management decisions, including opportunities to develop alternative timber markets or utilise the timber themselves where commercial markets are unavailable (FI6, FI7).

5.1.4 Learning

Individual cognitive learning

Cognitive learning was observed across stakeholder groups through experimentation and learning by doing, particularly among farm foresters (FF2, FF5). However, experimentation remained limited, partly due to reliance on external advisors for smaller entities, which constrained internal learning (FI4, FI5, FI8, FF5). Cognitive learning was further constrained by an aversion to change and a preference for simple solutions, limited understanding particularly of the non-linear nature of climate change, and difficulties integrating uncertainty and climate projections into decision-making with adaptation often perceived as requiring complete certainty before action could be taken (R1, R2). Furthermore, entrenched thinking, cognitive lock-ins, short-term perspectives, and expectations of visible returns reinforced existing *P. radiata* management in the industry, while Māori stakeholders adopted stronger intergenerational perspectives (C2, FI8). Additional constraints included limited interest and concern regarding climate change, and thus perceptions that adaptation was a “nice-to-have” rather than a necessity, resulting in a comparatively low priority for adaptation (FF3–FF5). Individual characteristics, including demographics, professional background, outdated knowledge, and limited experiential exposure among senior managers beyond clear-fell *P. radiata* forestry, further constrained learning (R2–R5). Conversely, younger staff, newcomers, overseas experience, greater gender diversity, and international networks were perceived to support learning and challenge established practices across all stakeholder groups (FI2, FI3).

Overall, cognitive learning was primarily observed through experimentation, particularly among farm foresters, but remained constrained by entrenched, short-term thinking and individual characteristics.

Social learning

Social learning was reported across parts of the forestry sector through observation of others, practical guidance by proactive forest owners, sector initiatives, well-informed personal networks, Environmental, Social, and Governance (ESG) requirements, the EU Taxonomy, and some Māori

entities (FI2, FI4). Catchment groups were perceived to facilitate social learning by bringing diverse stakeholders together, while companies increasingly recognised farm foresters as sources of knowledge on alternative tree species (TUR2, FI7, FI10, FF4). Farm foresters reported knowledge sharing with the wider industry, as well as awards that recognise environmental management as mechanisms supporting social learning on adaptation (FF2–FF6). International experience and globally connected companies provided additional learning opportunities (FF4, FI2, FI5, FI12). More broadly, advice from neighbours and companies demonstrating successful practices was perceived as particularly important in rural areas and currently more influential than formal policies (FI12, R1, R3, TUR2).

However, some opportunities were not realised, including within Māori trusts due to the voluntary and unpaid nature of participation and limited interest in council workshops (R6, MF1, FF5). Nevertheless, social learning remained an important element of capacity as participants suggested that transformative change will require a critical mass of individuals who recognise a shared problem and develop collective understandings of potential responses (FF5).

Institutional learning

Institutional learning was perceived as limited, partly due to the erosion and loss of institutional expertise following the centralisation of fire management through Fire Emergency New Zealand (FENZ), discontinued breeding programmes, institutional restructuring, and workforce retirement (FI3, FI7, FI10). This particularly concerned learning processes on species beyond *P. radiata*, as expertise accumulated during the more diverse plantation forestry of the 1960s–70s is concentrated among retiring foresters (FI8, FF2, FF4). Forestry education and sector institutions were perceived to reinforce this knowledge gap through a strong business and pine focus with limited attention to adaptation, although some recent shifts towards native species were reported (R4, FI8). Similarly, limited attention to adaptation by the FOA, TUR and Forest Growers Research (FGR) was perceived to constrain institutional learning in the sector (FI3, FF3). Extensive knowledge, research, and support structures around *P. radiata* further reinforced path-dependent learning and limited development of alternatives across all stakeholder groups (R4, FI3). However, some farm foresters and Māori entities maintained institutional learning around alternative species and traditional ecological knowledge, although Māori knowledge systems were described as disrupted by New Zealand's colonial history and as still undergoing processes of reclamation (FF1, FF4). Formal adaptation learning was reported among companies with ESG commitments and internal Research and Development (R&D), but was often small-scale or not mobilised (FI4–FI8). Thus, participants highlighted that learning does not necessarily result in risk minimisation (R1).

5.1.5 Resources

Physical and financial resources

Physical resources were perceived as an important component of the resource capacity element (FI4). Forest estates in lower-risk areas generally required fewer adaptation measures and generated greater financial resources available for adaptation, while exposed and costly locations faced the opposite conditions (FI1, FI5). Geographical diversification could reduce exposure to localised hazards but also increase transportation costs (R4, FI6, FI9, FI12). Māori forest owners reported particularly fragmented and less productive estates resulting from Treaty settlements, increasing management costs (MF1–MF3). Furthermore, resources were unevenly distributed with more profitable companies reporting access to firefighting equipment, infrastructure, and climate projections, while farm foresters highlighted access to modelling tools, GIS and GPS fencing, to support adaptation (FI2, FI6, FF3–FF6). Gaps included local wildfire suppression capacity linked to the aforementioned centralisation of fire management, tools for alternative species, and seedling availability beyond *P. radiata* (FI3, FI9).

Furthermore, limited financial resources were consistently perceived as constraining across stakeholder groups, particularly among smaller landowners and companies (FI1–FI4). Increasing costs due to compliance, certification, and rising energy prices, as well as declining industry and research funding further reduced available resources, with existing funding concentrated around *P. radiata* (FI1, FI3). Thus, financial support and incentives were considered particularly important for costly adaptation measures and alternative species with lower returns across all stakeholder groups (FF1, FF2). Simultaneously, participants emphasised that possessing financial resources does not necessarily result in adaptation. For instance, sufficient financial resources were perceived as enabling some companies to absorb the costs of post-disaster clean-up rather than investing in long-term adaptation (FI8, R4, R6). Similarly, farm foresters with substantial financial resources were described as not necessarily more effective in their adaptation behaviour (FI8). Thus, financial constraints were occasionally perceived as encouraging stakeholders to focus on fewer adaptation options and to adopt more selective adaptation strategies (C2).

Awareness, data availability and knowledge

Awareness of climate change risks and the need for adaptation was reported across all stakeholder groups (FI1–FI3). Māori forest owners reported particularly heightened awareness due to the exposure of their assets and anticipated impacts on their land and cultural identity (MF3, C3). Within the industry, awareness focused particularly on wildfire, windthrow, and biosecurity risks

(FI2, FI6).

Yet, perceptions of data availability for climate change adaptation varied considerably. Some participants identified data gaps on native forests, projected climate change, transition forestry, and alternative species, alongside outdated research and costly data access (R2, R6). Others considered climate data sufficiently available and accessible, with extensive scientific literature and research organisations providing information (MF4, FI4). Differences were partly attributed to limited awareness of available sources, insufficient proactive information seeking, and low interest in adaptation (TUR3, FF4, FI10).

Additionally, participants identified uncertainty around future climatic conditions and knowledge gaps related to the identified data gaps (FI1, FI3). Similar to the divergent opinions on data availability, others considered existing knowledge sufficient for adaptation, particularly when drawing on international research (R3, FF2). Knowledge was perceived as strongly concentrated around *P. radiata*, reflecting established institutional learning, while farm foresters reported stronger knowledge of alternative species but difficulties accessing and mobilising this knowledge due to sector fragmentation (FF1, FF2, FF5). The contrasting perspectives on data availability and knowledge may partly reflect participants' positions within information networks (FI12).

Employees and their expertise

While climate change denialism was not perceived as a dominant problem, participants stressed that limited understanding of climate change remained a challenge (MF1, MF4, FI11). Several participants emphasised uncertainty about whether observed extreme weather events could be directly attributed to climate change or framed climate change as a matter of personal opinion (MF1, FI5). Misconceptions further included expectations that ecosystems will sufficiently adjust naturally to climate change to maintain their existing functions, uniform benefits from carbon fertilisation, confusion between mitigation and adaptation concepts, and limited understanding of adaptation urgency (FI3, FI6). A limited internal knowledge base, skill gaps, staff shortages, and brain drain were further perceived to constrain capacity across stakeholder groups, particularly smaller companies, Māori trusts, and TUR (MF1, MF4). Conversely, well-informed employees, their operational experience, and local expertise were reported as important aspects of enhanced capacity, particularly given the site-specific nature of adaptation decisions (FI2, FI4).

Power

Stakeholders perceived substantial differences in power and influence over adaptation. Forestry was considered less influential than agriculture, while councils reported limited influence over industry

behaviour (FI1, FI12, INV1). Within companies, concentrated decision-making at management and shareholder levels was perceived to limit the influence of operational staff (FF4, R4). Māori forest owners reported power constraints linked to colonial legacies, but were also perceived as having considerable potential to lead adaptation due to the substantial size of their forest estates (MF3, NGO1). Farm foresters similarly perceived themselves as relatively powerless and dependent on larger entities for influence (FF2, FF5). This power imbalance was perceived in relation to the Forest Grower Levy Trust and research funding, where industry influence was reported by farm foresters to reinforce a *P. radiata* focus, although this was contested by industry participants (FF2–FF5, FI7, FI8).

5.2 Internal mobilisation of governance capacity for adaptation

As the examples presented in the preceding capacity analysis have shown, possessing governance capacity does not automatically result in adaptation action. Instead, different mechanisms have been observed as mobilising existing capacities. The following chapter focuses on the internal mobilisation of governance capacity for adaptation action.

5.2.1 Leadership and decision-making structures

Leadership emerged as an important mechanism for mobilising governance capacities. Individual initiative and dedicated sustainability personnel were reported to drive adaptation despite otherwise limited progress in the industry, while farm foresters highlighted their personal leadership and initiative in encouraging others to consider and implement adaptation measures (FI5, FI8). However, individual leadership was insufficient where owners, shareholders, clients, or senior management were not supportive (FI1, FI3). Support from decision-makers varied, with risk-averse or profit-oriented chief executives sometimes constraining adaptation, while long-term-oriented investors and clients were perceived to provide important leverage (C2, FF3). Thus, the structure of organisational decision-making further influenced whether governance capacities could be mobilised. Simpler ownership and management arrangements enabled faster decisions, whereas hierarchical structures were in some cases described as creating disconnects between operational knowledge and strategic decision-making (FI3, R4). Similar challenges were reported for Māori

trusts with complex collective ownership structures (MF1–MF4). Consequently, participants observed adaptive behaviour more frequently among smaller landowners, where management and ownership were often combined, than among larger organisations with more complex decision-making (FI3).

5.2.2 Norms, values and incentives

Decision-makers' motivation, values, long-term perspectives, and understanding of climate change were perceived as important in mobilising governance capacities (TUR1, TUR3). Organisational philosophies and global norms could similarly enable adaptation (FI3, FI6). Some farm foresters reported placing a stronger intrinsic value on the environment than either the forestry industry or agriculture, while for some Māori forest owners, adaptation was supported by their cultural identity, intergenerational thinking, and their relational approach to forests reflected in Māori concepts such as *kaitiakitanga* and *whakapapa* (FF1–FF5). In addition to underlying values, financial incentives, risk considerations, insurance conditions, and experiences of losses were observed triggers for mobilising capacities, while uncertainty could either motivate risk reduction or justify inaction (FI2, FI3). Conversely, short-term financial priorities, commercial and production-oriented values, including the perception of forests primarily as an economic resource and limited consideration of long-term sustainability, were perceived as major constraints to mobilisation (GOV1, TUR2). Participants therefore highlighted economic viability, alternative high-value species, ecosystem-service markets, and sustainable finance taxonomies for creating greater clarity around adaptation measures, thereby supporting informed investment decisions and incentivising foresters to integrate adaptation into management practices, as potential levers for mobilising governance capacities (FF4, FF5). Ultimately, transformative adaptation was perceived to require broader shifts in sectoral values and relationships with the environment (NGO1, R3).

5.2.3 Accountability

Clear accountability and responsibilities were also perceived as factors determining whether existing governance capacities were mobilised (C2, C3, FI2, FI10). In practice, however, participants frequently reported uncertainty over who should assume responsibility, particularly for funding adaptation, creating ambiguity around stakeholders' respective roles and constraining mobilisation (R3, R4). Ownership structures further shaped accountability. Overseas-owned companies were sometimes perceived as having weaker long-term commitments to New Zealand

and therefore less incentive to assume adaptation responsibilities, whereas locally owned or long-term-oriented companies were described as placing greater emphasis on community relationships and adaptive behaviour (FI3, FI11).

5.3 The external multilevel governance context

The multilevel governance and regulatory context represents an important external condition shaping stakeholders' capacity and its mobilisation (Adger et al. 2005). Other external influences included the sector's social licence (TUR1, R1), perceived media bias (NGO2, FI3), market conditions (TUR3, FI2), and path dependencies associated with existing processing infrastructure (MF1, FI7). While these broader contextual factors are acknowledged, the following section focuses on the regulatory and policy setting as the primary external governance condition.

5.3.1 Political-institutional setting

Stakeholders' governance capacity and its mobilisation were shaped by the broader governance system (R1). Participants perceived the privatisation of forestry in the 1980s as increasing fragmentation and constraining capacity compared with the former state-owned model, which provided greater alignment and clearer responsibilities (R2, R4). In the current context, fragmented multilevel governance and limited central-government guidance constrained coordination, while government initiatives and ESG frameworks supported more formal climate-risk processes (C1–C3). The legislative framework was also perceived as encouraging risk aversion, as decisions under uncertainty could result in liability if outcomes did not meet expectations, constraining experimentation, learning, and capacity mobilisation (GOV1, INV1, FI7, C2).

Institutional instability further constrained mobilisation through policy uncertainty associated with short political cycles and frequent policy changes (FI4, FI7). Limited political commitment to adaptation by the current government, a broader political culture characterised by an aversion to strategic and long-term planning as well as differences in council regulations were similarly perceived as complicating successful policy implementation and contributing to planning uncertainty (MF2, MF3). This was considered particularly problematic for long-term endeavours such as forestry and climate change adaptation, which require sustained planning and consistency over extended time frames. Participants therefore emphasised the importance of regulatory

consistency, both over time and across regions, as well as flexible policies supporting investment, innovation, and context-specific adaptation (C1, GOV1).

Overall, limited policy consistency and guidance were perceived as constraining stakeholders' capacity and its mobilisation.

5.3.2 Content analysis of adaptation policies

Only a small number of analysed policies directly address the issue of climate change adaptation of environmental systems, including the Aotearoa New Zealand Biodiversity Strategy (ANZBS) 2020, and several actions formulated within the National Adaptation Plan (NAP) 2022 (Digital Appendix 2). Issue-focused policies rely predominantly on regulatory and informational instruments (Digital Appendix 2). While the NAP was recognised as providing strategic direction (FI4, C3), it was also perceived as vague on responsibilities and lacking regulatory force (NGO1, GOV1). Existing instruments such as regulatory measures were considered partly insufficient to support adaptation due to associated costs, which can reduce the resources available for adaptation (FI1, FI4), and the forestry industry's historical success in avoiding additional regulatory burdens (R1, R5, NGO1). However, rising regulatory costs were also perceived as incentivising adaptation in some cases (R5, R6). Participants expressed interest in economic instruments, with biodiversity credits identified as a promising, albeit emerging, mechanism (FF2, R2). This discrepancy between the existing policy instruments and stakeholders' expectations suggests that issue-focused policies currently provide strategic guidance rather than acting as a strong driver of adaptation decisions (R3, INV1). Regarding implementation, most issue-focused policies are implemented by government agencies, while several policies rely on cooperation across agencies and administrative levels (Digital Appendix 2). For example, the Department of Conservation (DOC) Climate Adaptation Action Plans are implemented jointly by national and regional DOC offices in collaboration with local partners (DOC 2020).

Beyond these issue-focused adaptation policies, forest adaptation is primarily governed through broader policy areas. Policies related to climate change adaptation of environmental systems, such as programmes addressing severe weather management, and policies relevant to forest adaptation without explicitly mentioning the issue, outnumber issue-focused adaptation policies (Digital Appendix 2). Particularly, policies classified as relevant dominate, accounting for sixteen of the twenty-six policies analysed (Digital Appendix 2). Similarly to issue-focused policies, they rely predominantly on regulatory and informational instruments, with only limited use of economic instruments, and are implemented mainly by government agencies, often in cooperation across

administrative levels (Digital Appendix 2).

Overall, forest adaptation remains largely embedded in broader forestry and hazard frameworks, with a relatively small number of issue-focused policies suggesting that forest adaptation has received limited policy attention to date. This was also reflected in the interviews, where participants consistently described forest adaptation as a relatively low policy priority (R1, R2).

5.3.3 Policy coherence

A screening matrix assessing interactions between national, regional and local adaptation policies as well as between national adaptation and forest policy objectives identified predominantly enabling interactions (Digital Appendix 3 and 4). Broad objectives, such as reducing vulnerability and enhancing adaptive capacity, frequently supported other policy objectives, although this may partly reflect their general nature. Conflicting relations emerged between strengthening indigenous forests under the ANZBS and maximising forest carbon storage under the Maximising Forest Carbon Programme, as native species often sequester less carbon than exotic species and are therefore less economically competitive (FOA 2018, FI7–FI9). Stakeholders additionally perceived the Emissions Trading Scheme (ETS) as creating both constraints and opportunities for adaptation. While carbon-maximising incentives were perceived to constrain diversification, permanent forest cover and additional revenue streams were considered potential benefits for adaptation (MF1, MF2). More broadly, New Zealand's climate policy remains strongly mitigation-focused, framing forests primarily as carbon sinks rather than ecosystems requiring adaptation (Harbrow 2007, Climate Action Tracker 2023, FI9, INT1).

Overall, few direct policy conflicts were identified, mainly concerning indigenous versus exotic forestry and biodiversity versus carbon uptake. However, participants described the policy landscape as fragmented and difficult to navigate, with incoherence between policy objectives reducing clarity for operational decision-making (FI7, R1, NGO1).

6 Discussion

6.1 Limitations

While this study provides an in-depth, context-specific understanding of governance capacity for climate change adaptation in New Zealand's forestry sector, thereby responding to recent calls for

more qualitative and context-specific adaptive capacity research (Chapagain et al. 2025), the qualitative research design has several limitations. Participants were partly recruited through self-selection following a call for participation in a farm forestry newsletter, which may have resulted in the inclusion of participants who were more motivated, knowledgeable and interested in climate change adaptation than the average stakeholder. Consequently, the findings may over-represent proactive adaptation perspectives. In addition, the inclusion of multiple stakeholder groups resulted in relatively small sample sizes for individual groups, such as Māori forest growers and consultants ($n = 4$), limiting the extent to which conclusions can be drawn for specific stakeholder categories. Similarly, the characteristics of the participant sample, including the under-representation of women ($N = 42$, $n = 12$), may have influenced the perspectives captured in this study. The qualitative design also captures participants' perceptions, which are shaped by their individual experiences and perspectives, rather than providing an independent or objective measure of governance capacity. This became particularly apparent in the contrasting views expressed regarding the availability of data and knowledge on climate change. Therefore, further research potentially applying different research methods is required to better understand the underlying reasons for these contrasting perceptions. In addition, limitations inherent to semi-structured interviews include possible transcription errors and interviewer effects influencing responses (Creswell & Creswell, 2018). The presence of the interviewer may have encouraged socially desirable responses, potentially portraying adaptation efforts more positively than is currently the case. Furthermore, the capacity–mobilisation distinction is an analytical interpretation that is not directly observable in participants' accounts and therefore involves researcher judgement. The interpretation of the results may have been shaped by the researcher's socialisation in the European forestry context (Creswell & Creswell 2018).

Lastly, the cross-sectional design captures governance capacity at a single point in time. Both governance capacity and its mobilisation are dynamic and evolve in response to changing environmental, institutional, and social conditions (van Popering-Verkerk et al. 2022, Chapagain et al. 2025). Longitudinal research is therefore needed to better understand how governance capacities develop over time, how they are mobilised into adaptation action, and how these processes may contribute to more transformative forms of adaptation (Engle 2011, van Popering-Verkerk et al. 2022).

6.2 Comparison

While no studies to date have specifically analysed the governance capacity of New Zealand's

forestry sector for climate change adaptation, broader studies on adaptive capacity and adaptation enablers, including in different sectors or countries, have similarly highlighted coordination, collaboration, collective action, and learning as important capacities for adaptation (Rayner et al. 2013, Dilling et al. 2023, Brullo et al. 2024). Studies on adaptation in New Zealand's forestry sector applying different theoretical frameworks have reached similar conclusions. Wreford et al. (2021), for instance, used the concept of solution space to analyse the adaptive potential of forest stakeholders. Consistent with the findings presented in this study, they identified differences in capacity to adapt between stakeholder groups. A survey by Villamor et al. (2023a) identified a need for more climate change information from official authorities and research on adaptive capacity. This may reflect the requests for greater support from government authorities reported in this study and the divergent answers on whether there is sufficient data and knowledge on climate change available. In addition, the literature has identified limited resources and coordination challenges as important capacity constraints to adaptation in New Zealand's forestry sector, consistent with the presented findings (Villamor et al. 2023a, Lawrence et al. 2024). However, while diverse perspectives within Māori trust boards were considered a source of resilience in Wreford et al. (2021), participants in this study perceived the governance complexity of Māori trusts as limiting their capacity. In addition, Wreford et al. (2021) suggested that smallholders may have limited ability to influence and access technological resources. While this may apply to many smallholders, interviewed farm foresters in this study reported well-established use of technologies for climate change adaptation, including tools developed within farm forestry (FF2, FF3).

With regard to factors shaping capacities, the literature has highlighted strict profit orientation, power imbalances, and external market and infrastructure constraints as factors constraining capacities within the industry, while intergenerational and long-term planning among Māori forest owners and the growing influence of Māori concepts, as well as the high organisational flexibility of smallholders and sustainability taxonomies were identified as factors supporting capacities (Johnston & Hessel 2012, Bouriaud et al. 2015, Andersson et al. 2017, Wreford et al. 2021, Lawrence et al. 2024). These findings align with the results of this study. Consistent with the presented findings, the literature has identified motivation, trust, demographic characteristics and bringing in new perspectives, for instance through external stakeholders, to shape the governance capacity of the forestry sector (Bouriaud et al. 2015, Mortreux & Barnett 2017, Villamor et al. 2023a). However, while limited motivation and prevailing mindsets were reported as constraining governance capacities to adapt to climate change in this study, participants in Villamor et al. (2023a) did not identify these as major constraints. In addition, while climate denialism did not emerge as a prevailing constraint in either study, participants in the present study highlighted that a lack of

confidence in climate change limited governance capacity in some areas (FI11). Studies on adaptive capacity in different primary industries found the perception that stakeholders had successfully dealt with climate variability in the past, a limited understanding of the non-linearity and pace of climate change, as well as a low priority of adaptation as constraining capacities, similar to the findings presented here (Bay-Larson & Hovelsrud 2017). Nevertheless, the results have also shown that possessing capacities alone does not necessarily result in adaptation action. This suggests that while insufficient capacities may constrain adaptation, the presence of capacities does not automatically facilitate adaptation. Therefore, in line with previous findings of the literature, this study argues that governance capacities appear to constitute an important enabling condition for climate change adaptation, but are insufficient on their own to ensure adaptation action (Adger & Barnett 2009, Mimura et al. 2014, Bay-Larson & Hovelsrud 2017).

Considering the identified mobilisation mechanisms in this study, the literature has similarly found confidence in knowledge systems, willingness, capability, values, agency, worldviews, and individuals who provide leadership, vision, and meaning as important mobilisers of latent capacity (Folke et al. 2005, Mimura et al. 2014, Bay-Larson & Hovelsrud 2017, Freduha et al. 2018, Cinner et al. 2018, New et al. 2022, Glavovic et al. 2022, Dilling et al. 2023, Schubert et al. 2025). Risk attitudes and perception, damage experience, competing concerns, and ownership structures were furthermore linked to the prevention of, or mobilisation into adaptation action, supporting the findings (Bouriaud et al. 2015, Mortreux & Barnett 2017, Villamor et al. 2023b, Schubert et al. 2025, Hoeben et al. 2025). Consistent with the results of this study, Dunningham et al. (2012) found that the forestry sector's expectation of first obtaining a comprehensive understanding of climate change risks, impacts, and uncertainties hindered the implementation of adaptation. In addition to the mobilisers identified here, the literature has additionally highlighted the importance of place, identity, context, and culture (Bay-Larson & Hovelsrud 2017, Mortreux & Barnett 2017). Thus, these factors may also be worth exploring in the New Zealand forestry context.

Consistent with the multilevel governance context presented here, multiple studies have highlighted unclear roles and responsibilities, vertical coordination problems between administrative levels and horizontally between sectors, a lack of national adaptation policies and guidelines, a short-term focus of the political agenda, limited participatory approaches, a rigid regulatory environment, and unclear accountability as inhibiting adaptation action (Johnston & Hesseln 2012, Bouriaud et al. 2015, Mimura et al. 2014). Similarly, first government assessments in New Zealand revealed unclear and fragmented responsibilities, issues of equity, and limited or inadequate integration of adaptation into the legislative context (Ministry for the Environment 2024, Climate Change Commission 2024). The identified trade-offs between forest mitigation and adaptation goals have

recently been highlighted in the literature (Wang et al. 2026). In addition, the identified policy implementation challenges are consistent with the repeated failure to implement formulated climate change policies in New Zealand, complicating the creation of a supportive policy environment (Harbrow 2007). Although adaptation is often framed as the responsibility of individual organisations and landowners, participants emphasised that underlying barriers are often structural and therefore cannot be addressed through individual action alone (R1). While individual-level changes and agency are important mobilisers, this study also highlighted the limits of individual leadership. In line with the literature, it therefore argues that strengthening adaptation will require not only action by stakeholders but also broader systemic changes to the institutional and policy environment (Bay-Larson & Hovelsrud 2017, Hügel & Davies 2024).

Overall, the consistency of the findings with the existing literature suggests that the patterns identified in this study are not unique to the New Zealand forestry sector, but may reflect broader dynamics of governance capacity for climate change adaptation.

6.3 Theoretical contributions

Using the governance capacity framework introduced by van Popering-Verkerk et al. (2022), the following observations were made. First, the analysis showed that capacity elements were closely interrelated in practice. For instance, the capacity to recognise and cope with threats and the capacity to recognise and use opportunities were intertwined, with diversification of tree species described both as a response to climate-related threats and as an opportunity arising from restocking after disturbance events (FF3). Similarly, available data and knowledge shaped learning processes, and thus contributed to learning centred on *P. radiata* which, alongside financial investments, preventive switching-costs, and technological resources, reinforced institutional inertia. Reactive approaches were likewise influenced by the interaction of governance capacity elements, whereby both resource availability and learning from climate impacts influenced resilience. Additionally, although power was conceptualised as a resource in the applied framework, the findings also showed its influence on other capacities, such as collective action. Successful collective action in turn was most evident where trust, collaborative relationships, and complementary objectives enabled coordination, suggesting not only a close interaction of governance capacity elements, but also interdependencies between them. More broadly, these findings suggest that governance capacities do not operate independently in practice but form an interconnected system in which individual capacities reinforce or constrain one another, indicating that governance capacities may be more appropriately understood as an interconnected and dynamic system rather than as a

collection of independent capacities.

Second, beyond analysing the existing governance capacities of stakeholders, this study identified several conditions that shaped capacities. Mistrust, conflicting relationships, competition, institutional restructuring resulting in decreasing resources and overlapping functions, silo structures, entrenched networks, and power imbalances constrained collective action, coordination, and resources. Learning and resilience were constrained by cognitive lock-ins, short-term perspectives, limited interest and concern regarding climate change, workforce retirement, limited organisational flexibility, reactive approaches, and inertia linked to path dependencies around the dominant management system. In contrast, external government and industry projects bringing stakeholders together, the development of shared understanding, incentives in the form of financial rewards or recognition, new perspectives introduced through individuals from different forestry contexts or industries, and through a greater representation of younger people and women, were perceived to enable governance capacities. These findings are in line with van Popering-Verkerk et al.'s (2022) identification of trust and shared understanding as important conditions shaping governance capacities. The further identified conditions that either enabled or constrained governance capacities within New Zealand's forestry sector respond directly to van Popering-Verkerk et al.'s (2022) call for research examining factors that influence governance capacity.

Third, this study found that governance capacity does not necessarily result in adaptation action, supporting van Popering-Verkerk et al.'s (2022) conceptualisation of governance capacity as a potential that creates the preconditions for, but does not automatically result in, adaptation action. For instance, the availability of resources was sometimes reported as a constraint to adaptation action by enabling payments for clean-ups and litigation, suggesting that while financial resources are an important prerequisite for adaptation, their availability alone does not guarantee that adaptation measures will be implemented. Furthermore, participants provided several examples where knowledge, awareness, and information exchange regarding climate change did not translate into action, with the transition from recognising risks to implementing adaptation measures perceived as a major challenge to successful adaptation (FF5, R4). While van Popering-Verkerk et al. (2022) conceptualise governance capacity as a potential that can be deployed, their framework does not specify in detail the mechanisms through which this potential is translated into concrete action. This study contributes to a more detailed understanding of how governance capacity translates into adaptation action by identifying several case-specific mechanisms through which capacities were mobilised. In particular, leadership, changing values, mindsets, and relationships with nature, incentives, and clear accountability emerged as important mechanisms through which governance capacities were mobilised. While the mobilisation observed in this study primarily

related to incremental adaptation, it may represent an important precondition for more transformative forms of adaptation by laying the foundation for broader systemic change (Dilling et al. 2023). Future research should therefore not only focus on gaining a deeper understanding of how capacities can be mobilised into adaptation action, but also on how transformative adaptation can be facilitated.

Lastly, this study contributes to a more nuanced understanding of adaptation by distinguishing between governance capacities and the factors that mobilise them, thereby lending empirical support to recent calls for a clearer distinction between adaptation elements (Mortreux & Barnett 2017, Orlove 2022). Such a distinction may contribute to a more detailed understanding of adaptation processes by helping to explain why similar levels of governance capacity can result in different adaptation outcomes. Existing studies conceptualise the relationship between these dimensions in different ways, suggesting a need for greater conceptual clarity and a shared typology. For instance, Engle (2011) defines adaptive capacity partly in terms of a system's ability to mobilise resources, thereby framing mobilisation as an element of adaptive capacity. Similarly, Brullo et al. (2024) focus on enablers of actual adaptation while excluding adaptive capacity as an analytical category, rather than distinguishing between capacities and the mechanisms through which these capacities are mobilised. While van Popering-Verkerk et al. (2022) distinguish governance capacity as a potential from its actual deployment, their framework also continues to conceptualise the mobilisation of resources as an element of governance capacity itself. Similarly, they define collective action as encompassing the potential to perform actions (van Popering-Verkerk et al. 2022). This illustrates the conceptual overlap between capacities and their mobilisation in existing frameworks. Rather than indicating contradictory understandings, such differences reflect the lack of a consistent analytical distinction between what constitutes capacity and what enables its mobilisation. While it is widely recognised that capacities alone are insufficient to explain adaptation uptake (Mimura et al. 2014), the distinction between capacities and the factors shaping their mobilisation remains conceptually underdeveloped and inconsistently operationalised (Mortreux & Barnett 2017, Schubert et al. 2025). Therefore, this study argues that adaptation research may benefit from a clearer conceptual distinction between (i) capacities, (ii) enablers and constraints of capacities, and (iii) mobilisers of capacities. Such distinctions are essential for developing a more comprehensive understanding of the processes through which adaptation occurs and how it can be effectively supported (Orlove 2022). Further research could therefore benefit from systematically distinguishing between capacities as enabling preconditions and the mechanisms through which these capacities are mobilised into adaptation action.

7 Conclusion

This study has shown that governance capacity for climate change adaptation is unevenly distributed across and within forestry stakeholder groups in New Zealand. The analysis further demonstrated that governance capacities are not discrete attributes but interrelated and mutually reinforcing elements that interact in practice. Capacities were constrained by power imbalances, mistrust, conflicting relations, institutional restructuring, siloed and entrenched networks, inertia and reactive approaches, limited understanding of complexity, cognitive lock-ins, short-term perspectives, limited interest and concern regarding climate change, workforce retirement, and path dependency around current management systems. Capacities were enabled by the development of shared understanding, organisational flexibility, demographic changes, and incentives in the form of financial rewards or recognition. Importantly, the presence of governance capacities did not translate into adaptation action, indicating that governance capacity provides the potential for adaptation, but whether this potential is realised depends on additional factors. The findings show that the values, priorities, and leadership of individuals able to mobilise governance capacities are critical in determining whether existing capacities are mobilised into adaptation action. Moreover, the wider multilevel governance context can either enable or constrain this mobilisation, with the policy analysis highlighting that climate change adaptation of forests remains only weakly embedded in New Zealand's policy landscape.

These findings suggest that strengthening governance capacity alone is unlikely to be sufficient to accelerate adaptation. Rather, in the examined context, adaptation appears to require not only enhancing governance capacities to establish the conditions for adaptation across stakeholder groups but also fostering the institutional, organisational, and leadership conditions that enable these capacities to be mobilised and translated into action. Future research could further build on this distinction by examining how governance capacities are mobilised across different governance contexts and sectors, thereby assessing the broader applicability of these findings beyond New Zealand's forestry sector.

References

- Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change*, 15(2), 77–86.
<https://doi.org/10.1016/j.gloenvcha.2004.12.005>

- Adger, W. N., & Barnett, J. (2009). Four Reasons for Concern about Adaptation to Climate Change. *Environment and Planning A*, 41(12), 2800–2805. <https://doi.org/10.1068/a42244>
- Andersson, E., Keskitalo, E. C. H., & Lawrence, A. (2017). Adaptation to Climate Change in Forestry: A Perspective on Forest Ownership and Adaptation Responses. *Forests*, 8(12), 493. <https://doi.org/10.3390/f8120493>
- Arifin, S. R. (2018). Ethical Considerations in Qualitative Study. *INTERNATIONAL JOURNAL OF CARE SCHOLARS*, 1(2018), 30–33. <https://doi.org/10.31436/ijcs.v1i2.82>
- Bay-Larson, I. & Hovelsrud, G. K. (2017). Chapter 10. Activating Adaptive Capacities: Fishing Communities in Northern Norway. In: G. Fondahl, G.N. Wilson (eds.), *Northern Sustainabilities: Understanding and Addressing Change in the Circumpolar World*. Springer Polar Sciences, 123–134. 10.1007/978-3-319-46150-2_10
- Bernard, R. H. (2006). *Research Methods in Anthropology – Qualitative & Quantitative Approaches* (4th edn). AltaMira Press. 803 pp.
- Bernier, P. & Schoene, D. (2009). Adapting forests and their management to climate change: an overview. *Unasylva*, 60(No. 231/232). Online under: <https://www.fao.org/4/i0670e/i0670e02.htm> (last accessed 10.08.2026).
- Berrang-Ford, L., Siders, A. R., Lesnikowski, A., Fischer, A., Callaghan, M., Haddaway, N., Mach, K., Araos, M., Shah, M. A. R., Wannewitz, M., Doshi, D., Leiter, T., Matavel, C., Musah-Surugu, J., Wong-Parodi, G., Antwi-Agyei, P., Ajibade, I., Chauhan, N., Kakenmaster, W., Minx, J. (2021). A systematic global stocktake of evidence on human adaptation to climate change. *Nature Climate Change*, 11(11), 989–998. <https://doi.org/10.1038/s41558-021-01170-y>
- Bloomberg, M. & Ulrich, S. (2025). Lessons for steepland forestry harvesting in New Zealand from recent Resource Management Act prosecutions. *New Zealand Journal of Forestry*, 70(2), 3–9.

- Bloomberg, M. (2026). What changes are needed to New Zealand forestry given the expected future increase in frequency of storm events? *New Zealand Journal of Forestry*, 70(4), 44.
- Bouriaud, L., Marzano, M., Lexer, M., Nichiforel, L., Reyer, C., Temperli, C., Peltola, H., Elkin, C., Duduman, G., Taylor, P., Bathgate, S., Borges, J. G., Clercx, S., Garcia-Gonzalo, J., Gracia, C., Hengeveld, G., Kellomäki, S., Kostov, G., Maroschek, M., Muys, B., Nabuurs, G., Nicoll, B., Palahí, M., Rammer, W., Ray, D., Schelhaas, M., Sing, L., Tomé, M., Zell, J., Hanewinkel, M. (2015). Institutional factors and opportunities for adapting European forest management to climate change. *Regional Environmental Change*, 15(8), 1595–1609. <https://doi.org/10.1007/s10113-015-0852-8>
- Bressers, H. T. & Kuks, S. (2003). What Does "Governance" Mean? From Conception to Elaboration. In: Bressers, H. T. & Rosenbaum, W. A. (eds.), *Achieving Sustainable Development* (65-88). USA: Greenwood Publishing. 10.5040/9798400606571.ch-004.
- Brullo, T., Barnett, J., Waters, E., Boulter, S. (2024). The enablers of adaptation: A systematic review. *Npj Climate Action*, 3(1), 40. <https://doi.org/10.1038/s44168-024-00128-y>
- Burch, S. (2010). Transforming barriers into enablers of action on climate change: Insights from three municipal case studies in British Columbia, Canada. *Global Environmental Change*, 20(2), 287–297. <https://doi.org/10.1016/j.gloenvcha.2009.11.009>
- Capano, G., & Howlett, M. (2024). Calibration and specification in policy practice: Micro-dimensions of policy design. *Policy Design and Practice*, 7(2), 115–128. <https://doi.org/10.1080/25741292.2024.2353929>
- Chapagain, P. S., Banskota, T. R., Shrestha, S., Khanal, N. R., Yili, Z., Yan, J., Linshan, L., Paudel, B., Rai, S. C., Islam, M. N., Paudel, K. R. (2025). Studies on adaptive capacity to climate change: a synthesis of changing concepts, dimensions, and indicators. *Humanit Soc Sci Commun*, 12(2025). <https://doi.org/10.1057/s41599-025-04453-3>
- Cinner, J. E., Adger, W. N., Allison, E. H., Barnes, M. L., Brown, K., Cohen, P. J., Gelcich, S., Hicks, C. C., Hughes, T. P., Lau, J., Marshall, N. A., Morrison, T. H. (2018). Building adaptive capacity to climate change in tropical coastal communities. *Nature Climate Change*,

8(2018), 117–123. <https://doi.org/10.1038/s41558-017-0065-x>

Climate Action Tracker (2023). New Zealand. Online under: <https://climateactiontracker.org/countries/new-zealand/policies-action/> (last accessed 14.04.2026).

Climate Change Commission (2024). Progress report: National Adaptation Plan – Assessing progress on the implementation and effectiveness of the Government’s first national adaptation plan. Wellington: Climate Change Commission. 278 pp.

Clinton, P., Coker, G., Dovey, S., Garrett, L., Rolando, C., Slade, A., Smaill, S., Stewart, C., Xue, J. (2025). Achieving greater forest resilience and productivity through innovation and targeted nutrition. *New Zealand Journal of Forestry*, 70(2), 10–16.

Cradock-Henry, N., Blackett, P., Hall, M., Johnstone, P., Teixeira, E., Wreford, A. (2019). Applying adaptation pathways with Hawke’s Bay primary industries. POLICY BRIEF NO. 22, Manaaki Whenua Landcare Research, 1–6.

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Los Angeles: SAGE Publications, Inc. 438 pp.

Davison, M. (2024). 'Goodbye Freddy'. *Forest & Bird magazine*, 1(2024). Online under: <https://www.forestandbird.org.nz/resources/goodbye-freddy> (last accessed 21.04.2026).

Department of Conservation (2020). Department of Conservation climate change adaptation action plan - Te Papa Atawhai he whakamahere hātepe urutau mō te huringa āhuarangi 2020/21 – 2024/25. Wellington: Department of Conservation. 80 pp.

DiCicco-Bloom, B., & Crabtree, B. (2006). The qualitative research interview. *Medical Education*, 40(2006), 314–321. <https://doi.org/10.1111/j.1365-2929.2006.02418.x>

Dickinson, Y., Klinger, S., Payn, T., Knoke, T., Salekin, S. (2025). Continuous Cover Forestry (CCF) as a potential response to challenges facing Aotearoa New Zealand. *New Zealand Journal of Forestry*, 69(4), 11–19.

- Dilling, L., Daly, M. E., Travis, W. R., Ray, A. J., Wilhelmi, O. V. (2023). The role of adaptive capacity in incremental and transformative adaptation in three large U.S. Urban water systems. *Global Environmental Change*, 79(2023). <https://doi.org/10.1016/j.gloenvcha.2023.102649>
- Dunningham, A., Kirschbaum, M., Payn, T., Meason, D. (2012). Chapter 7. Forestry Long-term adaptation of productive forests in a changing climatic environment. In: Clark, A.J., & Nottage, R.A.C. (eds.), *Impacts of Climate Change on Land-based Sectors and Adaptation Options*. Technical Paper No: 2012/33. Wellington: Ministry for Primary Industries. 408 pp.
- EDS (2025). EDS says proposals for climate adaptation have significant gaps. Online under: <https://eds.org.nz/resources/documents/media-releases/2025/eds-says-proposals-for-climate-adaptation-have-significant-gaps/> (last accessed 22.04.2026).
- EDS (2026a). Climate. Spotlight on Climate. Online under: <https://eds.org.nz/our-work/climate/> (last accessed 22.04.2026).
- EDS (2026b). Climate Change Adaptation. Project Overview. Online under: <https://eds.org.nz/our-work/policy/projects/climate-change-adaptation/> (last accessed 22.04.2026).
- Engle, N. L. (2011). Adaptive Capacity and Its Assessment. *Global Environmental Change*, 21(2), 647–656. 10.1016/j.gloenvcha.2011.01.019.
- FAO (2001). State of the world's forests. Climate change and forests. Rome: FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, 65–73. Online under: https://www.fao.org/4/y0900e/y0900e06.htm#P0_0 (last accessed 10.08.2026).
- FAO (2023). FAO elearning Academy. Institutionalization of forest data. Online under: <https://elearning.fao.org/course/view.php?id=977> (last accessed 02.11.2025).
- Fischlin, A., Midgley, G. F., Price, J., Leemans, R., Gopal, B., Turley, C., Rounsevell, M., Dube, P., Tarazona, J., Velichko, A. (2007). Ecosystems, their properties, goods, and services. In: Parry, M. L., Canziani, O. F., Palutikof, J. P., van der Linden, P. J., Hanson, C. E. (eds.), *Climate*

change 2007: impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press, 211–272.

Fischer, A. P., Shah, M. A. R., Segnon, A. C., Matavel, C., Antwi-Agyei, P., Shang, Y., Muir, M., Kaufmann, R. (2024). Human adaptation to climate change in the context of forests: A systematic review. *Climate Risk Management*, 43(2024), 1–17.
<https://doi.org/10.1016/j.crm.2023.100573>

Folke, C., Hahn, T., Olsson, P., Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, 30(2005), 441–473.
<https://doi.org/10.1146/annurev.energy.30.050504.144511>

FOA (2007). Need for national RMA debate endorsed. Online under: <https://www.nzfoa.org.nz/news/foa-news/foa-media-releases-2007/977-211107foa> (last accessed 07.04.2026).

FOA (2014). FOA history. Online under: <https://www.nzfoa.org.nz/about/foahistory> (last accessed 07.04.2026).

FOA (2018). Zero Carbon Act solution in planting more trees. Online under: <https://www.nzfoa.org.nz/news/foa-news/foa-media-releases-2018/1596-080318-foanews> (last accessed 07.04.2026).

FOA (2020a). Forest industry says main political parties abandon forest industry at economic and environmental cost. Online under: <https://www.nzfoa.org.nz/news/foa-news/foa-media-releases-2020/1653-taxpayers-to-pick-up-carbon-cost-if-production-forests-are-restricted-2> (last accessed 07.04.2026).

FOA (2020b). LEGAL SUBMISSIONS ON BEHALF OF THE NEW ZEALAND FOREST OWNERS ASSOCIATION INCORPORATED. 28 pp. Online under: <https://www.nzfoa.org.nz/resources/file-libraries-resources/submissions/2020> (last accessed 16.04.2026).

- FOA (2022). FOA media releases 2021. Online under: <https://www.nzfoa.org.nz/news/foa-news/foa-media-releases-2021?start=0> (last accessed 07.04.2026).
- FOA (2023). Future forests need to be multifunctional to meet climate change in Tairāwhiti. Online under: <https://www.nzfoa.org.nz/news/foa-news/foa-media-releases-2021?start=0> (last accessed 08.04.2026).
- Forest & Bird (2017). Government must heed new report on adapting to climate change. Online under: <https://www.forestandbird.org.nz/resources/government-must-heed-new-report-adapting-climate-change> (last accessed 21.04.2026).
- Forest & Bird (2018). Urgent planning for climate change needed for people and wildlife. Online under: <https://www.forestandbird.org.nz/resources/urgent-planning-climate-change-needed-people-and-wildlife> (last accessed 21.04.2026).
- Forest & Bird (2019). Forest & Bird backs the Zero Carbon Bill, calls for more methane reductions. Online under: <https://www.forestandbird.org.nz/resources/forest-bird-backs-zero-carbon-bill-calls-more-methane-reductions> (last accessed 21.04.2026).
- Forest & Bird (2022). Forest & Bird Submission on the Draft National Adaptation Plan. Online under: <https://www.forestandbird.org.nz/resources/forest-bird-submission-draft-national-adaptation-plan> (last accessed 21.04.2026).
- Forest & Bird (2024). Nature-based solutions welcomed in new climate strategy – but short on detail. Online under: <https://www.forestandbird.org.nz/resources/nature-based-solutions-welcomed-new-climate-strategy-short-detail> (last accessed 21.04.2026).
- Forest & Bird (2025a). What we do. Online under: <https://www.forestandbird.org.nz/what-we-do> (last accessed 21.04.2026).
- Forest & Bird (2025b). Sharp drop in environmental spending amid growing risks for nature. Online under: <https://www.forestandbird.org.nz/resources/sharp-drop-environmental-spending-amid-growing-risks-nature> (last accessed 21.04.2026).

- Forest & Bird (2026a). Resource Library. Online under:
<https://www.forestandbird.org.nz/resources/library> (last accessed 21.04.2026).
- Forest & Bird (2026b). Submission guide: Natural Environment Bill and Planning Bill. Online under:
<https://www.forestandbird.org.nz/resources/submission-guide-natural-environment-bill-and-planning-bill> (last accessed 21.04.2026).
- Freduah, G., Fidelman, P., & Smith, T. F. (2018). Mobilising adaptive capacity to multiple stressors: Insights from small-scale coastal fisheries in the Western Region of Ghana. *Geoforum*, 91(2018), 61–72. <https://doi.org/10.1016/j.geoforum.2018.02.026>
- Giessen, L., Sarker, P. K., & Rahman, M. S. (2016). International and domestic sustainable forest management policies: distributive effects on power among state agencies in Bangladesh. *Sustainability*, 8(4). <https://doi.org/10.3390/su8040335>
- Glavovic, B. C., Dawson, R., Chow, W., Garschagen, M., Haasnoot, M., Singh, C., Thomas, A. (2022). Cross-Chapter Paper 2: Cities and Settlements by the Sea. In: Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.), *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, NY, USA, 2163–2194. 10.1017/9781009325844.019.
- Grimble, R., & Chan, M.-K. (1995). Stakeholder analysis for natural resource management in developing countries. *Natural Resources Forum*, 19(2), 113–124. <https://doi.org/10.1111/j.1477-8947.1995.tb00599.x>
- Gupta, J., Termeer, C., Klostermann, J., Meijerink, S., van den Brink, M., Jong, P., Nooteboom, S., Bergsma, E. (2010). The Adaptive Capacity Wheel: A method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science & Policy*, 13(6), 459–471. <https://doi.org/10.1016/j.envsci.2010.05.006>
- Hall, P. A. (1993). Policy paradigms, social learning, and the state: the case of economic policymaking in Britain. *Comparative politics*, 25(1993), 275–296.

- Harbrow, M. R. (2007). Trends in New Zealand climate change policy 1988 – 2006. Published Master thesis. Albany: Massey University. 111 pp. <http://hdl.handle.net/10179/10330>
- Hoeben, A. D., Lautrup, M., Willig, J., García-Jácome, S. P., Jankovský, M., Toppinen, A., Vuletić, D., Peltoniemi, M., Stern, T. (2025). Stakeholder views of adaptation measures to improve climate resilience: Case study evidence from European wood value chains. *Forest Policy and Economics*, 170, 103379. <https://doi.org/10.1016/j.forpol.2024.103379>
- Hügel, S. & Davies, A. R. (2024). Expanding adaptive capacity: Innovations in education for place-based climate change adaptation planning. *Geoforum*, 150(2024). [10.1016/j.geoforum.2024.103978](https://doi.org/10.1016/j.geoforum.2024.103978)
- Huitema, D., Adger, W. N., Berkhout, F., Massey, E., Mazmanian, D., Munaretto, S., Plummer, R., Termeer, C. C. J. A. M. (2016). The governance of adaptation: choices, reasons, and effects. Introduction to the Special Feature. *Ecology and Society*, 21(3), 1–15. <http://dx.doi.org/10.5751/ES-08797-210337>
- ICNZ (2015). SUBMISSION OF THE INSURANCE COUNCIL OF NEW ZEALAND ON NEW ZEALAND'S CLIMATE CHANGE TARGET. 3 pp. Online under: <https://www.icnz.org.nz/industry/submissions/?e-page-64b8865=4> (last accessed 22.04.2026).
- ICNZ (2023). ICNZ SUBMISSION ON PROPOSED INCREASE TO THE FIRE AND EMERGENCY TRANSITIONAL LEVY FOR THE 2024/25 AND 2025/26 FINANCIAL YEARS. 12 pp. Online under: <https://www.icnz.org.nz/industry/submissions/?e-page-64b8865=2> (last accessed 22.04.2026).
- ICNZ (2025). October 16, 2025. Online under: <https://www.icnz.org.nz/industry/media-releases/govts-national-adaptation-framework-a-vital-first-step/> (last accessed 22.04.2026).
- IPCC (2001). Climate change 2001: Impacts, Adaptation, and Vulnerability: Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. McCarthy, J. J., Canziani, O. F., Leary, N. A., Dokken, D., White, K. (eds.), Cambridge, UK: Cambridge University Press.

- IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.), Cambridge, UK and New York, NY, USA: Cambridge University Press, 3056 pp. 10.1017/9781009325844.
- Ishtiaque, A. (2021). Chapter 10 - Multilevel governance in climate change adaptation: Conceptual clarification and future outlook. In: Fares, A. (eds.), Climate Change and Extreme Events. Elsevier, 171–185. <https://doi.org/10.1016/B978-0-12-822700-8.00009-3>
- Johnston, M., & Hessel, H. (2012). Climate change adaptive capacity of the Canadian forest sector. *Forest Policy and Economics*, 24(2012), 29–34. <https://doi.org/10.1016/j.forpol.2012.06.001>
- Lawrence, J., Mackey, B., Chiew, F., Costello, M. J., Hennessy, K., Lansbury, N., Nidumolu, U. B., Pecl, G., Rickards, L., Tapper, N., Woodward, A., & Wreford, A. (2022). Australasia. In: Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.), Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, UK and New York, USA: Cambridge University Press, 1581–1688. 10.1017/9781009325844.013.
- Lawrence, J., Wreford, A., Blackett, P., Hall, D., Woodward, A., Awatere, S., Livingston, M. E., Macinnis-Ng, Cate, Walker, S., Fountain, J., Costello, M. J., Ausseil, A. E., Watt, M. S., Dean, S. M., Cradock-Henry, N. A., Zammit, C., Milfont, T. L. (2024). Climate change adaptation through an integrative lens in Aotearoa New Zealand. *Journal of the Royal Society of New Zealand*, 54(4), 491–522. <https://doi.org/10.1080/03036758.2023.2236033>
- Little, C. (2026). Effect of Cyclone Gabrielle on Wairoa and forestry industry relationship. *New Zealand Journal of Forestry*, 70(4), 3–6.
- Marshet, N. G. & Fekadu, H. H. (2019). Review on Effect of Climate Change on Forest

- Matariki Forests (2026). Search Results. Online under: <https://www.matarikiforests.co.nz/search-results/?query=climate+change> (last accessed 22.04.2026).
- Mayring, P. (2015). *Qualitative Inhaltsanalyse* (12th ed.). Weinheim: Beltz Verlag. 153 pp.
- McCormick, M. (2025). The past, the present and the next rotation – reflections of a regional council Environmental Protection Officer. *New Zealand Journal of Forestry*, 70(2), 34–37.
- Meason, D. F., & Mason, W. L. (2014). Evaluating the deployment of alternative species in planted conifer forests as a means of adaptation to climate change—Case studies in New Zealand and Scotland. *Annals of Forest Science*, 71(2), 239–253. <https://doi.org/10.1007/s13595-013-0300-1>
- Mimura, N., Pulwarty, R. S., Duc, D.M., Elshinnawy, I., Redsteer, M.H., Huang, H.Q., Nkem, J.N., Sanchez Rodriguez, R.A. (2014). Adaptation planning and implementation. In: Field, C. B., Barros, V. R., Dokken, D. J., Mach, K. J., Mastrandrea, M. D., Bilir, T. E., Chatterjee, M., Ebi, K. L., Estrada, Y. O., Genova, R. C., Girma, B., Kissel, E. S., Levy, A. N., MacCracken, S., Mastrandrea, P. R., White, L. L. (eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press, 869–898.
- Ministry for the Environment (2024). New Zealand’s first Biennial Transparency Report under the Paris Agreement. Wellington: Ministry for the Environment. 394 pp.
- Ministry for Primary Industries (2023). Importance of New Zealand forests. Online under: <https://www.mpi.govt.nz/forestry/new-zealand-forests-forest-industry/importance-new-zealand-forests> (last accessed 18.03.2026).
- Mortreux, C. & Barnett, J. (2017). Adaptive capacity: exploring the research frontier. *WIREs Clim Change*, 8(4). <https://doi.org/10.1002/wcc.467>

- Nelson, D. R., Adger, W. N., & Brown, K. (2007). Adaptation to environmental change: contributions of a resilience framework. *Annu Rev Env Resour*, 32(1), 395–419. [10.1146/annurev.energy.32.051807.090348](https://doi.org/10.1146/annurev.energy.32.051807.090348)
- New, M., Reckien, D., Viner, D., Adler, C., Cheong, S.-M., Conde, C., Constable, A., Coughlan de Perez, E., Lammel, A., Mechler, R., Orlove, B., Solecki, W. (2022). Decision-Making Options for Managing Risk. In: Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.), *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, UK and New York, USA: Cambridge University Press, 2539–2654. 10.1017/9781009325844.026.
- New Zealand Climate Change Centre (2010). *Climate change adaptation in New Zealand: Future scenarios and some sectoral perspectives*. Nottage, R.A.C., Wratt, D.S., Bornman, J.F., Jones, K. (eds.) Wellington: New Zealand Climate Change Centre. 136 pp.
- Nilsson, M., Zamparutti, T., Petersen, J. E., Nykvist, B., Rudberg, P., McGuinn, J. (2012). Understanding Policy Coherence: Analytical Framework and Examples of Sector–Environment Policy Interactions in the EU. *Env. Pol. Gov.*, 22(6), 395–423. <https://doi.org/10.1002/eet.1589>
- Nilsson, M., Griggs, D. & Visbeck, M. (2016). Policy: Map the interactions between Sustainable Development Goals. *Nature*, 534(2016), 320–322. <https://doi.org/10.1038/534320a>
- North, D. C. (1991). Institutions. *The Journal of Economic Perspectives*, 5(1), 97–112.
- Oberlack, C. (2017). Diagnosing institutional barriers and opportunities for adaptation to climate change. *Mitig Adapt Strateg Glob Change*, 22(2017), 805–838. <https://doi.org/10.1007/s11027-015-9699-z>
- O’Brien, G., O’Keefe, P., Rose, J., Wisner, B. (2006). Climate change and disaster management. *Disasters*, 30(1), 64–80. <https://doi.org/10.1111/j.1467-9523.2006.00307.x>

- Oregon Group (2023). How we are. Growing for tomorrow. Online under: <https://www.ernslaw.co.nz/how-we-work/growing-for-tomorrow> (last accessed 22.04.2026).
- Orlove, B. (2022). The Concept of Adaptation. *Annual Review of Environment and Resources*, 47(2022), 535–581. <https://doi.org/10.1146/annurev-environ-112320-095719>
- Parmesan, C., Morecroft, M. D., Trisurat, Y., Adrian, R., Anshari, G.Z., Arneth, A., Gao, Q., Gonzalez, P., Harris, R., Price, J., Stevens, N., Talukdarr, G.H. (2022). Terrestrial and Freshwater Ecosystems and Their Services. In: Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.), *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, UK and New York, USA: Cambridge University Press, 197–377. 10.1017/9781009325844.004.
- Quinlan, P. (2025). Continuous Cover Forestry from scratch – planting mixed species and developing an irregular forest structure. *New Zealand Journal of Forestry*, 70(2), 29–34.
- Quinlan, P., & Aimers, J. (2025). Difficulties managing regenerating tōtara under Part 3A of the Forests Act. *New Zealand Journal of Forestry*, 70(3), 40–45.
- Rayner, J., McNutt, K., & Wellstead, A. (2013). Dispersed Capacity and Weak Coordination: The Challenge of Climate Change Adaptation in Canada’s Forest Policy Sector. *Review of Policy Research*, 30(1), 66–90. <https://doi.org/10.1111/ropr.12003>
- Rhodes, R. A. W. (1996). The New Governance: Governing without Government. *Political Studies*, 44(4), 652–667. <https://doi.org/10.1111/j.1467-9248.1996.tb01747.x>
- Schubert, A., von Streit, A., & Garschagen, M. (2025). Unravelling the capacity–action gap in flood risk adaptation. *Nat. Hazards Earth Syst. Sci.*, 25(5), 1621–1653. <https://doi.org/10.5194/nhess-25-1621-2025>
- Schusser, C., Krott, M., Yufanyi Movuh, M. C., Logmani, J., Devkota, R. R., Maryudi, A., Salla, M. (2016). Comparing community forestry actors in Cameroon, Indonesia, Namibia, Nepal and

Germany. *Forest Policy and Economics*, 68(2016), 81–87.
<https://doi.org/10.1016/j.forpol.2016.03.001>.

Sperlich, D., Nadal-Sala, D., Gracia, C., Kreuzwieser, J., Hanewinkel, M., & Yousefpour, R. (2020). Gains or Losses in Forest Productivity under Climate Change? The Uncertainty of CO₂ Fertilization and Climate Effects. *Climate*, 8(12), 141. <https://doi.org/10.3390/cli8120141>

Summit Forests (2026). About. Online under: <https://summitforests.co.nz/about/> (last accessed 22.04.2026).

van Popering-Verkerk, J., Molenveld, A., Duijn, M., van Leeuwen, C., van Buuren, A. (2022). A Framework for Governance Capacity: A Broad Perspective on Steering Efforts in Society. *Administration & Society*, 54(9). <https://doi.org/10.1177/00953997211069932>

Varvasovszky, Z. & Brugha, R. (2000). How to do (or not to do) ... a stakeholder analysis. *Health policy and planning*, 15(3), 338–345. [10.1093/heapol/15.3.338](https://doi.org/10.1093/heapol/15.3.338)

Villamor, G. B., Dunningham, A., Stahlmann-Brown, P., Clinton, P. W. (2022). Improving the Representation of Climate Change Adaptation Behaviour in New Zealand's Forest Growing Sector. *Land*, 11(3), 364. <https://doi.org/10.3390/land11030364>

Villamor, G. B., Wakelin, S. J., & Clinton, P. W. (2023a). Climate change, risk perceptions and barriers to adaptation among forest growers in New Zealand. *Journal of the Royal Society of New Zealand*, 54(4), 433–448. <https://doi.org/10.1080/03036758.2023.2218103>

Villamor, G. B., Wakelin, S. J., Dunningham, A., Clinton, P. W. (2023b). Climate change adaptation behaviour of forest growers in New Zealand: An application of protection motivation theory. *Climatic Change*, 176(2), 3. <https://doi.org/10.1007/s10584-022-03469-x>

Wang, S., Zhang, Y., Ju, W., Chen, J. M., Ciais, P., Cescatti, A., Sardans, J., Janssens, I., Wu, M., Berry, J., Campbell, E., Fernández-Martínez, M., Alkama, R., Sitch, S., Friedlingstein, P., Smith, W., Yuan, W., He, W., Lombardozzi, D., Penuelas, J. (2020). Recent global decline of CO₂ fertilization effects on vegetation photosynthesis. *Science*, 370(2020). 1295–1300. [10.1126/science.abb7772](https://doi.org/10.1126/science.abb7772).

- Wang, R., Li, C., An, Z., Chang, S. X. (2026). Climate-smart forestry: Strategies, policies, and technologies for enhancing climate change mitigation and ecosystem sustainability. *Climate Smart Agriculture*, 3(2). <https://doi.org/10.1016/j.csag.2026.100110>
- Watt, M. S., Kirschbaum, M. U. F., Moore, J. R., Pearce, H. G., Bulman, L. S., Brockerhoff, E. G., Melia, N. (2019). Assessment of multiple climate change effects on plantation forests in New Zealand. *Forestry: An International Journal of Forest Research*, 92(1), 1–15. <https://doi.org/10.1093/forestry/cpy024>
- West, G. (2025). Resilient forest design – a new approach. *New Zealand Journal of Forestry*, 70(2), 23–28.
- Woods, N. (2025). Learnings from dealing with the 2023 cyclone crisis – Aratu Forest’s perspective. *New Zealand Journal of Forestry*, 70(3), 8–11.
- Wreford, A., Dunningham, A., Jones, A., de Oca Munguia, O. M., Villamor, G. B., Monge, J. J. (2021). Exploring the solution space for different forestry management structures in New Zealand under climate change. *Environmental Science & Policy*, 126(2021), 1–10. <https://doi.org/10.1016/j.envsci.2021.09.010>
- Young, J. (2021). Time to talk adaptation? *Forest & Bird magazine*, 2(2021). Online under: <https://www.forestandbird.org.nz/resources/time-talk-adaptation> (last accessed 21.04.2026).

Appendix

Appendix 1: Stakeholder mapping

Current climate change adaptation legislation and parties

Regarding the Spatial Planning Act, the Natural and Built Environment Act, and the Climate Adaptation Act suggested to replace the RMA in 2023: Opposed by the Parties National, ACT and Māori parties (National-led Coalition Government), fulfilled its commitments in the National-ACT and National-NZ First Coalition Agreements by repealing these three acts and due to its complexity,

being perceived as too centralized, being too bureaucratic and not sufficiently addressing the problems of the RMA. The new government wants an updated bill to replace the RMA with a clear legislation for property rights. The repeal of the three proposed acts was criticised by NGOs such as the Royal Forest and Bird Protection Society of New Zealand (Davison 2024).

The acts were supported by the Labour and Green parties, although the Greens argued that it was not sufficient to protect the environment. FOA criticised the RMA in the early 2000s as not sufficient in promoting sustainability (FOA 2007).

Labor and National are criticised in a recent political statement by the FOA for their forest policies, while ACT, the Opportunities Party, New Zealand First Party and the Green party are pointed out by the FOA for having goals in place that will support the forestry industry (FOA 2020a). For the newly planned replacement legislation for the RMA the NGO Royal Forest and Bird Protection Society of New Zealand has already published a statement criticising the limited role of climate change adaptation in the replacement bills and advocating for NBS (Forest & Bird 2026b).

New Zealand Institute of Forestry

The New Zealand Journal of Forestry is published by the New Zealand Institute of Forestry (NZIF), that understands itself as representing forest professionals in New Zealand. They publish a mix of scientific peer-reviewed articles and opinion pieces by academics and professionals, including farm foresters and NGO representatives. A review of recent articles showed that several of the published articles discuss sustainable forest management such as continuous cover forestry (CCF), and enhancing forest resilience (Dickinson et al. 2025, Clinton et al. 2025, West 2025, Quinlan 2025). Furthermore, recent articles revealed a strong focus on storm hazards (Woods 2025, Little 2026, Bloomberg 2026). In regard to the RMA, an article in the NZIF by Bloomberg & Ulrich (2025) discusses the remaining risks for logging slash under the RMA and recommends reducing clearfell coupe sizes on erosion-prone land as well as limiting access to land if risk of non-compliance is high, thereby highlighting perceived limitations of the existing regulatory framework. Furthermore, the Forest Act is criticised by Quinlan & Aimers (2025) in favour of sustainable indigenous forestry. McCormick (2025) additionally argues that training and engagement are necessary for a successful uptake of legislation on severe weather events in local communities.

Thus, articles published in the NZIF show a strong recognition of needed adaptation in the forestry sector (West 2025). Regulatory policies are criticised as not sufficient enough to ensure climate resilient forests. At the same time, it is pointed out that support to meet legislative requirements is needed. Generally, the NZIF shows supportive tendencies on the issue of climate change adaptation

of New Zealand's forests.

Forest Owners Association

The Forest Owners Association (FOA) represents New Zealand's commercial plantation forest growers since the early 20th century with the aim to promote and protect their interest (FOA 2014). Although the FOA media releases targets climate change since the beginning of its media releases and recently in nearly every second released articles, the focus of these articles remains exclusively on mitigation, for instance discussing the ETS, carbon farming and sequestration targets (FOA 2022). Subsequently they voiced support for the Climate Change Response (Zero Carbon) Amendment Act 2019, the Billion Trees programme, and the creation of an independent Climate Commission. Furthermore, they strongly support exotic plantations for carbon sequestration and meeting New Zealand's goal under the PA while regularly criticising efforts to favour native forests (FOA 2018). Therefore, they oppose the approach in regard to regenerated indigenous biodiversity in plantation forest as formulated in the National Policy Statement on Indigenous Biodiversity (NPSIB), one of the analysed policies on ecosystem adaptation, in a legal submission from 2020 (FOA 2020b). Furthermore, although recognising increasing challenges from climate change related disturbances such as pest, forest fires and erosion, adaptation of forests is not discussed in any of the articles published by the FOA since 2003. In line with these findings, a review of online media releases indicated that New Zealand's largest forestry companies make only limited reference to climate change adaptation (Oregon Group 2023, Summit Forests 2026, Matariki Forests 2026).

New Zealand Farm Forestry Association

The New Zealand Farm Forestry Association (NZFFA) discusses native forests more favourably than the FOA. Some published articles focus on climate change mitigation, furthermore, the relevance of a multifunctional forest in light of climate change is discussed, although only focusing on the functions carbon sequestration, slope stability and decreasing soil erosion (FOA 2023)

eNGOs

One of the most influential NGOs on forest ecosystems in New Zealand is the Royal Forest and Bird Protection Society of New Zealand (Forest & Bird 2025a). They voice strong support of climate change adaptation, first published articles on the topic are available since 2017 with regular online commentaries starting in 2011 (Forest & Bird 2026a). In 2018 they called for a national adaptation plan and supported the Zero Carbon Amendment Act while at the same time pushing for broader recognition of NBS within the Act (Forest & Bird 2018; 2019). The NGO commented on

the draft NAP in 2022, overall supporting the document, but advocating a stronger application of NBS in the plan (Forest & Bird 2022). Similarly, they criticised the government's climate change strategy for its lack of detail on NBS (Forest & Bird 2024). In general, the Royal Forest and Bird Protection Society of New Zealand prominently advocates adaptation of the environment. Forests are mostly viewed as an NBS for climate change adaptation (Forest & Bird 2017). The need to adapt forests themselves is initially acknowledged, for instance by discussing translocation (Young 2021).

Other environmental NGOs such as the Environmental Defense Society (EDS) similarly advocate for climate change adaptation by contributing submissions and regularly pointing out limits of governmental adaptation strategies (EDS 2025). While they recognise the need to adapt forests to climate change with a focus on native ecosystems, their media release on adaptation predominately discusses managed retreat (EDS 2026a; 2026b).

Insurance

In addition to these organizations, the insurance sector plays a prominent role in advocating for climate change adaptation in New Zealand. Industry representatives, particularly the Insurance Council of New Zealand, began promoting adaptation-related considerations in policy discussions around the time of the PA in 2015 and have since repeatedly contributed submissions addressing climate risk and adaptation (ICNZ 2015). In subsequent years, they have continued to support the NAP and have advocated for sustained, cross-party collaboration to advance a comprehensive national adaptation framework (ICNZ 2025). Furthermore, the insurance sector has highlighted the increasing risks that climate change poses to the forestry sector, particularly through the heightened likelihood and severity of wildfires. Submissions note both infrastructural constraints to adaptation, such as limited accessibility in remote forested areas, which can complicate a fast response of FENZ, and behavioural factors, including relatively low levels of forest insurance coverage (ICNZ 2023).

Summary

All in all, non-governmental stakeholders display varying degrees of support for climate change adaptation in the forestry sector. While the FOA, representing commercial forest owners in New Zealand, acknowledges the risks that climate change poses to forests in its media communications, it provides only limited substantive engagement with adaptation strategies. At the same time, it strongly advocates exotic plantation forestry. By contrast, eNGOs tend to prioritise native forests

and recognise the need for forest-related adaptation, albeit often at a general level. Research-oriented organisations such as the NZIF, alongside insurance companies such as the ICNZ, emerge as comparatively strong proponents of climate change adaptation in the natural environment.

Appendix 2: Analysed policies overview

Name	Administrative level	Source	Analysed
National Adaptation Plan 2022, Chapters 6-10	national	Ministry for the Environment (2022). Aotearoa New Zealand's first national adaptation plan. Wellington: Ministry for the Environment. 193 pp.	yes
Climate Change Response Act 2002	national	New Zealand Legislation (2026). Climate Change Response Act 2002. Online under: https://www.legislation.govt.nz/act/public/2002/40/en/latest/#DLM158584 (last accessed 10.03.2026).	yes
Climate Change Response (Zero Carbon) Amendment Act 2019	national	New Zealand Legislation (2026). Climate Change Response (Zero Carbon) Amendment Act 2019. Online under: https://www.legislation.govt.nz/act/public/2019/61/en/latest/#LMS183736 (last accessed 10.03.2026)	yes
National Climate Change Risk Assessment 2020	national	Ministry for the Environment (2020). National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Aotearoa: Pūrongo whakatōpū.	yes

		Wellington: Ministry for the Environment. 133 pp.	
Resource Management Act 1991	national	New Zealand Legislation (2026). Resource Management Act 1991. Online under: https://www.legislation.govt.nz/act/public/1991/69/en/latest/ (last accessed 10.03.2026).	yes
Soil Conservation and Rivers Control Act 1941	national	New Zealand Legislation (2026). Soil Conservation and Rivers Control Act 1941. Online under: https://www.legislation.govt.nz/act/public/1941/12/en/latest/#DLM230365 (last accessed 10.03.2026).	yes
Local Government Act 2002	national	New Zealand Legislation (2026). Local Government Act 2002. Online under: https://www.legislation.govt.nz/act/public/2002/84/en/latest/#DLM172987 (last accessed 11.03.2026).	yes
Natural Hazard Insurance Act 2023	national	New Zealand Legislation (2026). Natural Hazard Insurance Act 2023. Online under: https://www.legislation.govt.nz/act/public/2023/1/en/latest/#LMS509591 (last accessed 11.03.2026).	yes
Severe Weather Emergency Legislation Act (SWELA) 2023	national	New Zealand Legislation (2026). Severe Weather Emergency Legislation Act 2023. Online under: https://www.legislation.govt.nz/act/public/2023/4/en/latest/#LMS822431 (last accessed 11.03.2026).	yes
Severe Weather Emergency Recovery Legislation	national	New Zealand Legislation (2026). Severe Weather Emergency Recovery Legislation Act 2023. Online under:	yes

Act (SWERLA) 2023		https://www.legislation.govt.nz/act/public/2023/17/en/latest/#LMS825612 (last accessed 11.03.2026).	
Rotorua Climate Action Plan 2021	local	Rotorua Lakes Council (2021). Mahere Tauhohe Huarere Rotorua Climate Action Plan. Rotorua: Rotorua Lakes Council. 50 pp.	yes
Sustainable Living Strategy 2020	local	Rotorua Lakes Council (2020). Rotorua Sustainable Living Strategy – Refresh Toitū te ora o Rotorua. A Community View He hāpori rautaki He kōrero a te iwi. Rotorua: Rotorua Lakes Council. 29 pp.	yes
Department of Conservation Climate Adaptation Action Plan 2025-28	national	Department of Conservation (2025). Climate change adaptation action plan 2025–28. Wellington: Department of Conservation. 21 pp.	yes
Department of Conservation Climate Adaptation Action Plan 2021-24	national	Department of Conservation (2020). Department of Conservation climate change adaptation action plan - Te Papa Atawhai he whakamahere hātepe urutau mō te huringa āhuarangi 2020/21 – 2024/25. Wellington: Department of Conservation. 80 pp.	yes
Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy (ANZBS) 2020	national	Department of Conservation (2020). Te Mana O Te Taiao Aotearoa New Zealand Biodiversity Strategy 2020. Wellington: Department of Conservation. 72 pp.	yes
National Policy	national	Ministry for the Environment (2026).	yes

Statement on Indigenous Biodiversity		National Policy Statement for Indigenous Biodiversity 2023 Amended December 2025. Online under: https://environment.govt.nz/publications/national-policy-statement-for-indigenous-biodiversity-2/ (last accessed 11.03.2026).	
Sustainable Land Management Hill Country Erosion Programme	national	Ministry for Primary Industries (2026). Hill Country Erosion Programme for councils. Online under: https://www.mpi.govt.nz/forestry/funding-tree-planting-research/hill-country-erosion-programme (last accessed 11.03.2026).	yes
Forest and Rural Fires Act 1977	national	New Zealand Legislation (2026). Forest and Rural Fires Act 1977. Online under: https://www.legislation.govt.nz/act/public/1977/52/en/latest/#DLM442947 (last accessed 11.03.2026).	yes
Forestry Encouragement Act 1962	national	New Zealand Legislation (2026). Forestry Encouragement Act 1962. Online under: https://www.legislation.govt.nz/act/public/1962/20/en/latest/#DLM339608 (last accessed 11.03.2026).	yes
Forests Act 1949	national	New Zealand Legislation (2026). Forests Act 1949. Online under: https://www.legislation.govt.nz/act/public/1949/19/en/latest/#DLM255626 (last accessed 12.03.2026).	yes
Resource Management	national	New Zealand Legislation (2026).	yes

(National Environmental Standards for Commercial Forestry) Regulations 2017		Resource Management (National Environmental Standards for Commercial Forestry) Regulations 2017. Online under: https://www.legislation.govt.nz/secondary-legislation/pco-drafted/2017/174/en/latest/#DLM7373521 (last accessed 12.03.2026).	
Maximising forest carbon programme	national	Ministry for Primary Industries (2026). Maximising forest carbon. Online under: https://www.mpi.govt.nz/forestry/forest-science-and-research/maximising-forest-carbon (last accessed 12.03.2026).	yes
Fire Emergency NZ Response strategy 2022-30	national	Fire Emergency New Zealand (2026). Climate change and wildfire risk. Online under: https://www.fireandemergency.nz/about-us/our-commitments/our-climate-is-changing/ (last accessed 12.03.2026).	yes
Climate Strategy of the Government	national	New Zealand Government (2024). Responding to a changing climate. The Government's climate strategy. Wellington: Ministry for the Environment. 3 pp.	yes
Sustainable Land Management and Climate Change Adaptation Programme	national	Ministry for Primary Industries (2026). Sustainable Land Management and Climate Change Adaptation Programme. Online under: https://www.mpi.govt.nz/funding-rural-support/farming-funds-and-programmes/slmacc/slmacc-adaptation	yes

		(last accessed 12.03.2026).	
Civil Defence Emergency Management Act 2002	national	New Zealand Legislation (2026). Civil Defence Emergency Management Act 2002. Online under: https://www.legislation.govt.nz/act/public/2002/33/en/latest/#LMS824185 (last accessed 12.03.2026).	yes
The National Disaster Resilience Strategy	national	Ministry of Civil Defence & Emergency Management (2019). National Disaster Resilience Strategy - Rautaki ā-Motu Manawaroa Aituā. Wellington: Ministry of Civil Defence & Emergency Management. 49 pp.	yes
National Adaptation Framework	national	New Zealand Government (2025). National Adaptation Framework. Wellington: Ministry for the Environment. 4 pp.	yes
Forest Futures Action Plan Rotorua	local	CNI Wood Council, Scion, Te Uru Rakau New Zealand Forest Service, Toi Ohomai Te Pūkenga, Rotorua Lakes Council, RotoruaNZ, & Whenua Oho (2023). Rotorua Forest Futures Action Plan 2023-2026. Rotorua. 49 pp.	yes
Bay of Plenty Climate Change Action Plan	regional	Bay of Plenty Regional Council (2023). Te Mahere Mahi mō te Huringa Āhuarangi Climate Change Action Plan 2024-26. Kia manawatoa a Te Moana-o-Toitehuatahi Working towards a climate resilient Bay of Plenty. Whakatāne: Bay of Plenty	yes

		Regional Council. 16 pp.	
Climate Change Statement of the Bay of Plenty Regional Council (BOPRC)	Regional	Bay of Plenty Regional Council (2026). Our Climate Change Statement. Online under: https://www.participate.boprc.govt.nz/1tp/our-climate-change-statement (last accessed 13.03.2026).	yes
Climate Change (Forestry) Regulations 2022	National	New Zealand Legislation (2026). Climate Change (Forestry) Regulations 2022. Online under: https://www.legislation.govt.nz/secondary-legislation/pco-drafted/2022/266/en/latest/#LMS709536 (last accessed 13.03.2026).	yes
Impacts of Climate Change on Land-Based Sectors and Adaptation Options – Forestry Chapter	National	Dunningham, A., Kirschbaum, M., Payn, T., & Meason, D. (2012). Chapter 7. Forestry Long-term adaptation of productive forests in a changing climatic environment. In: Impacts of Climate Change on Land-based Sectors and Adaptation Options. Clark, A.J., & Nottage, R.A.C. (eds). Technical Paper No: 2012/33. Wellington: Ministry for Primary Industries. 408 pp.	yes
Biennial Transparency Report	National	Ministry for the Environment (2024). New Zealand's first Biennial Transparency Report under the Paris Agreement. Wellington: Ministry for the Environment. 394 pp.	yes

Appendix 3: Interview guides for stakeholders

Interviewer: Lilly Tinzmann

Contact: +4915254023771

lilly.tinzmann@mailbox.tu-dresden.de

Interview guide for stakeholders

Information shared with the interviewee:

The interview is part of an independent research conducted for a Master's thesis at the Chair of International and Tropical Forestry at TU Dresden, that is jointly supervised by the university and Scion (BSI).

The interview is expected to take 30 to 60 minutes, depending on the interviewee's availability. Prior to the interview, the questions will be sent to the interviewee via email for their reference. Additional follow-up questions may be asked during the interview.

The interview will be recorded if permission is granted by the interviewee. All interviews will be anonymised, recordings and transcripts will not be shared with any third party.

Interviewees will have the opportunity to receive the results of the study in the form of the thesis once it has been graded, or as a scientific article if the results are published in a journal.

Questions:

Context

1. Can you briefly describe your forest management (type, species, management approach)?
2. Have you experienced climate change impacts, or do you expect them in the future?
3. Are you adapting your forest management to climate change, if yes how?

Administrative structure

5. How do different levels of governance (local, regional, national) influence your ability to adapt?
6. Are there challenges e.g. with coordination or unclear responsibilities across these levels?
7. Follow-up on (mal-)coordination of different levels, information of the public, sufficient tools and advice provided.

Policies

8. Which policies or regulations most affect your adaptation decisions and how? Follow-up on named policies.
9. What policy changes would make adaptation easier for you?
-

Information & networks

10. Where do you get information about climate risks and adaptation? How useful is it?
11. Do your personal networks, or professional organisations such as the FOA influence your decisions? How?
12. Are there values or traditions that shape how you approach forest management?
-

Additional

13. Have you heard about the National Adaptation Plan? Are you aware of the actions outlined in the NAP for forests, such as the forest advisory tool? How useful do you perceive these action?
14. Have you heard about the Aotearoa New Zealand's Biodiversity Strategy and the Policy Statement on Indigenous Biodiversity? Will these policies support the uptake of adaptation actions?
15. What stakeholders are most prominent in climate change adaptation of forest or other ecosystems in New Zealand?
16. Do you receive clear guidance from authorities on climate change adaptation?
17. What trade-offs between short-term profitability and long-term resilience are there?
-

Appendix 4: Interview guide for stakeholders

Interviewer: Lilly Tinzmann
Contact: +4915254023771
lilly.tinzmann@mailbox.tu-dresden.de

Interview guide for stakeholders

Information shared with the interviewee:

The interview is part of independent research conducted for a Master's thesis at the Chair of International and Tropical Forestry at TU Dresden and is jointly supervised by the university and Scion (BSI).

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The interview will be recorded if permission is granted by the interviewee. All interviews will be anonymised, recordings and transcripts will not be shared with any third party.

Interviewees will have the opportunity to receive the results of the study in the form of the thesis once it has been graded, or as a scientific article if the results are published in a journal.

Questions

Administrative structure

1. How does the administrative structure enable or constrain adaptation in the forestry sector?
 2. Follow-up on between level exchange and communication and within?
 3. Is intersectoral exchange and communication on adaptation taking place and how does enable or constrain adaptation?
 4. Are challenges regarding coordination occurring (over-coordination, lack of coordination, silo problem)?
 5. How is public information enforced? Does it enable or constrain adaptation? (open-access data platforms, ensure equitable, inclusive learning or limited access to information?)
 6. Are there conflict prevention mechanisms e.g. for enhancing transparency, rescaling authority to a less conflict prone authority, in place?
-

Policies

7. Does NZ legislative structure enable or constrain adaptation, how (regulatory un/certainty, lack of formal institutions)?
 8. Are there sufficient accountability mechanisms (responsibility enforcement, monitoring, evaluating etc.) in place?
 9. Why is a recurrent policy failure observable when it comes to implementation of forest adaptation and mitigation policies? (see Kyoto and recent acts 2023)
 10. How adequate are informational and cooperative policy instruments to support adaptation in comparison to economic instruments that are applied for most mitigation policies?
-

Informal institutions

11. How do informal institutions such as norms and expectations constrain or enable adaptation?
 12. Are there specific in/effective institutions (e.g. for conflict prevention, path-dependency, stable or inconsistent institutions e.g. contradicting and limited adaptiveness) in place that constrain or enable adaptation, if yes how?
 13. Does the support of a Māori worldview (Whakapapa and Kaitiakitanga) facilitate adaptation and if yes how?
 14. Does a strong cooperate identity, norm of reciprocity, institutionalised communication, agreed monitoring and evaluation mechanisms, collaborative attitude support adaptation, and if yes how?
 15. Does an integrative narrative that frames climate change as a cross-scale challenge, rescaling functional interdependence of actions, exist?
-

Stakeholder

16. Who/ which organization is most influential/ powerful to advance adaptation?
 17. Who is affected most by climate change and will profit most from adaptation?
 18. Does social-learning, communication and strong engagement of stakeholders with previous experience exist?
 19. Are flexible boundary rules in place or boundary rules that restrict eligibility of stakeholders, who might choose maladaptive options?
 20. Is intrinsic motivation of participants and short-term adaptation of stakeholders encouraged?
 21. Are participatory adaptation processes in place?
 22. Are incentives for adaptation provided?
 23. Do arenas for knowledge sharing, joint learning and coordinate learning processes exist?
 24. Is there a high number of stakeholders (transaction costs, limited efficiency) and open-access (too heterogeneous preferences and thus ineffectiveness of decision-making)?
 25. Are there power asymmetries?
 26. Is limited communication and trust (lack of knowledge, learning and knowledge exchange) between stakeholders occurring?
 27. Is there high competition between stakeholders and limited incentives in this competitive setting due to limited law enforcement?
-

Additional questions depending on expertise:

28. Since there is a focus on mitigation through forest sinks, what is done to ensure permanence?

29. What is the Policies and Measures focus under the Paris Agreements NDCs and why?
 30. Is a temporal mismatch between adaptation action and disturbance observable?
 31. Is long-term adaptation complicated by extrinsic incentives such as financial rewards that can cease?
 32. Have you heard about the NAP? What has changed since its introduction?
-

Appendix 5: Ethical clearance TU Dresden



Technische Universität Dresden | Pienner Strasse 7, 01737 Tharandt

To whom it may concern

Chair of Tropical and International Forestry,
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Subject: Ethical clearance for research study by Lilly Tinzmann

Dear Ladies and Gentlemen,

In my capacity as Academic Advisor I herewith certify that:

04/05/2026

- Ms. Lilly Tinzmann (Date of Birth: 23.10.2001) is a student enrolled in the Joint Master Program in Global Forestry (Erasmus Mundus) and is currently hosted at the TUD Dresden University of Technology
- The research is titled "Enablers and Constraints of Multilevel Governance for Climate Change Adaptation in Aotearoa New Zealand's Forestry Sector"
- Data collection will take place from May to July 2026
- The work is done under the supervision of Dr. Kendisha Soekardjo Hintz (TUD Dresden University of Technology) and Dr. Grace L. Villamor (Scion)
- The intended work has passed the routine ethical clearance procedures established in our program
- The work has the full support of the scientific supervisor and myself.

I would appreciate if you could support this candidate in your own capacities.

Eckhard
Friedhelm Auch

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Appendix 6: Interviews supporting findings

Finding/ Theme	Page	Supporting interviews
Collective action, facilitators	15	INV1, FI1, FI2, FI8, FF2
Collective action limitation through conflicts with regulatory authorities	15	FI1, FI5, FI7, FI8, FI10, FI12, FF1, FF3, FF5, C3, MF4
Collective action, more powerful agricultural sector	15	MF1, MF2, NGO1, C2, FI1, FI8, FI11, FI12, INV1, FF1, FF2, FF4, FF5
Coordination, examples of well established information exchange within stakeholder groups	15	FF1–FF6, NGO2, TUR2, TUR3, FI4, FI7–FI10, FI12, INV1, MF2
Coordination, examples of constraints to information exchange within stakeholder groups	15	FF2, FF3, FF5, FF6, TUR3
Coordination, examples of well established information exchange within the sector and examples of intermediary organisations	15	NGO1, NGO2, MF2, MF3, TUR3, C1, C3, FF1, FF6, FI1–FI5, FI7, FI8, FI12, R2
Coordination, further examples on fragmentation and pine-related constraints to information exchange within the sector	16	MF4, GOV1, C1, R1, R2, NGO2, FI7, FI8, FI11, FI12, FF1, FF4
Collaboration, examples	16	FI2, FI5, FI7, FI8, FI12, NGO2, FF1, TUR2, TUR3
Collaboration, limitations	16	C1, R1, R2, FI4, FI7, FI8, FI11
Mistrust between forestry and councils	16	FI1, FI3, FI7–FI10, FF1, FF2, C3, R6
Mistrust forestry and	16	FF2, FF4–FF6, FI3, NGO2

agriculture		
Windows of opportunity	16	FI6, FI8, FI9, NGO2, FF3, R1, R6
Reactive approach of the forestry industry	17	R1-R6, MF4, FI11, NGO1, FF5, TUR2
Reasons for reactive approach	17	R2, FF5, INT1, GOV1, FI7, C2
Predominance of incremental adaptation	17	TUR1, FF2, FF3, FF5, FF6, R3–R4, NGO2, FI3
Reasons for continued <i>P. radiata</i> focus	17	FF5, TUR1, TUR2, R2, FI8, MF3, NGO2
Limited interest in alternative systems	17	R2, FI8, TUR1, TUR2, FF1, FF5, MF3, NGO2
Incremental change as either insufficient or necessary	17	GOV1, FF5, R3, TUR1, FI3
Continued reliance of <i>P. radiata</i> in relation to flexibility	17	FF3, FI1, FI3, FI7, FI12
Further explanations for limited agility	18	R1, R2, R6, FI5, FI6, FI9, FI10, FF3, FF5
Greater flexibility of farm foresters	18	FI6, FI7, FF2–FF6, R6
Cognitive learning through experimentation etc.	18	FF2, FF5, FF6, FI2, FI5, FI9, FI10, C3, TUR2, NGO2
Cognitive learning constraints in relation to complexity and non-linearity of climate change etc.	18	R1, R2, R4, R6, MF1, MF4, NGO2, FI1, FI3, FI5, FI7, FI8, INV1, TUR3, C2
Cognitive learning constraints in relation to entrenched thinking etc.	18	C2, FI8, FF2, FF5, MF1, MF3, NGO2, R3, R5, TUR1, R2
Cognitive learning constraints in relation to limited interest and overconfidence etc.	18	FF3–FF5, FI1, FI3, FI6–FI10, FI12, R1, R4–R6, INT1
Cognitive learning constraints in relation to individual	18	R2–R5, FF5, FI3, FI8

characteristics including demographics etc.		
Cognitive learning enablers in relation to younger people, international networks etc.	18	FI2, FI3, FI5, FI8, FI12, R2, R3, FF4, FF6, C2, C3, NGO2, MF2
Social learning examples	19	FI2, FI4, FI5, MF1, MF2
Institutional learning constraints in relation to university training	19	R4, FI8, MF1, FF4, TUR3
Institutional learning constraints in relation to limited attention by organisations	19	FI3, FF3, FF4, FI10, R2
Institutional learning constraints in relation to path-dependent learning	19	R4, FI3, FI7, FF2–FF5, GOV1, MF3, NGO2
Institutional learning of Māori and farm foresters	19	FF1, FF4, TUR1, MF2, MF3, R6
Institutional learning examples but to a limited extent	20	FI4–FI8, FI12, INV1, R2, R6, NGO2, FF3–FF5, MF2, MF4, TUR3
Physical resources, low/ high cost estates	20	FI1, FI5, FI6, FI8, FI9, FI11, FI12, MF1, R2, R4
Fragmentation of Māori forest estates	20	MF1–MF3, NGO2, C2
Gaps in physical resources	20	FI3, FI9, FI10, FF4, FF5
Limited financial resources as a general challenge	20	FI1–FI4, FI6–FI10, MF2–MF4, NGO2, INV1, R2, R4–R6, FF1, FF5, C2, TUR3
Examples for reasons of limited financial resources	20	FI1, FI3, FI8, FI9, FI12, R1–R3, R6, INV1, C3, FF4, FF5
Importance of financial support	20	FF1, FF2, FF4, FF6, R2, R4, R6, FI3, FI4, FI7–FI11, NGO2, TUR2, MF1, MF4
General high awareness of the	20	FI1–FI3, FI5, FI7, FI11, FI12,

forestry sector		R2, R5, R6, MF1, MF4, INV1, NGO2, C2, FF1, FF3–FF5
Awareness focus of industry	21	FI2, FI6, FI9, FI12, R6, FF5
Data gaps	21	R2, R6, FI3, FI5, FI7–FI9, FI11, FI12, TUR1–TUR3, NGO2, MF2, FF2
Available data as sufficient	21	MF4, FI4, FI5, FI12, C1, TUR3, FF4, FF5, NGO2)
Knowledge gaps and uncertainty related to limited data	21	FI1, FI3, FI5, FI7, FI8, FI10–FI12, R6, TUR2, FF5, FF6
Sufficient knowledge	21	R3, FF2, FF4, FF5, TUR1, TUR3
Participants expressing forms of scepticism	21	MF1, FI5, FI6, FI9, FI12, FF5
Further misconceptions	21	FI3, FI6, FI9–FI12, R3–R5, TUR2, TUR3, MF4
Limited internal knowledge base and other constraints	21	MF1, MF4, R4, FI3, FI7, FF1–FF4
Well-informed employees as assets	21	FI2, FI4, FI8, FI12, R2, FF3
Forestry less powerful than agriculture	22	FI1, INV1, C2, C3, R5, R6, NGO2
Power constraints of Māori forest owners	22	MF3, NGO1, NGO2, FI2, TUR1
Power imbalance of farm foresters in relation to the forest grower levy trust etc.	22	FF2–FF5, FI7, FI8
Leadership as an important enabler of adaptation particularly in farm forestry	22	FI5, FI8, FI10, GOV1, TUR2, C2, MF4, FF3–FF6
Limits of individual leadership	22	FI1, FI3, FI4, FI8, FI10
Varied support from decision-makers'	22	C2, FF3, FF4, FI2, FI3, FI5, FI6, FI8, FI10, FI12, R4, R5

Simpler management/ ownership structures as enablers	22	FI3, FI10-FI12, R4, FF2-FF5
Decision-makers values as enablers of mobilisation	23	TUR1, TUR3, C3, R2, R3, FI4, FI8
Organisational philosophies and global norms	23	FI3, FI6, FI7, FI12, INV1, R2, R3, TUR3
Farm forestry and Māori values as enablers	23	FF1–FF5, R2, R6, TUR1, TUR2, MF3, MF4, NGO2, FI5- FI7, C1, C3
Financial incentives etc. as enablers	23	FI2, FI3, FI5, FI6, FI8, FI12, R3, R5, R6, MF4, INV1, TUR3
Value constraints to adaptation such as profit orientation	23	GOV1, TUR2, TUR3, R2, R6, FI5, FI9, C1, C3, FF3, FF5, NGO1
Economic viability and taxonomies as enablers	23	FF4, FF5, R2, R4–R6, FI7, FI10, R5, NGO1, NGO2
Uncertainty about accountability in practice	24	R3, R4, C1, C3, GOV1
Overseas-owned versus locally owned companies	24	FI3, FI11, FI2, NGO1, NGO2, R6, C3
The sector's social licence	24	TUR1, C1-C3, R1, R2, R5, NGO1, MF2, MF3, FI1-FI3, FI5, FI8, FF1
Biased media coverage	24	NGO2, FI3, FI10, FI12, MF1, FF2, R4, INV1
Market conditions	24	TUR3, FI2, FI3, FI6, FI9, R6, INV1
Path-dependencies related to existing processing infrastructure	24	MF1, FI1-FI3, FI7, FI10, FI12, TUR2, TUR3, R6, NGO2
Past government decisions and privatisation of the forestry sector and public versus private	24	R2, R4, GOV1, FI3, FI5, FI9, MF3, MF4, NGO2

owned forest		
Constraints in the current multilevel governance context	24	C1–C3, FI2–FI4, FI7, FI10, NGO2, TUR3
Constraints of the multilevel governance context in relation to mobilisation	24	FI4, FI7, NGO2, TUR1, MF2, INV1
Further constraints including lack of political commitment etc. to planning certainty	24	MF2, MF3, R1–R5, FI3, FI4, FI6, FI7, FI9, FF4, FF5, C1, C3, GOV1, NGO2
Need for regulatory consistency	25	C1, GOV1, FI4, FI5, FI7, NGO2
Limited explicit policy attention	25	R1, R2, R5, MF4, INV1
Limits of NAP	25	NGO1, GOV1, FI7, FI9, R3, R5, C3
Costs of regulatory instruments as constraints	25	FI1, FI4, FI9, FI6, FI10, FI12, FF5, C2, R5
Costs of regulatory instruments as enablers	25	R5, R6, NGO1, FF5, FI8, FI11, FI12, TUR3
Interest in economic policy instruments and biodiversity credits	25	FF2, R2, R4–R6, FI1–FI4, C1, C3, INV1, TUR1, TUR2, INT1, GOV1, FF4, NGO1, NGO2, MF3
NAP not as a strong driver to date	25	R3, INV1, FI2, FI5, FI7, FI9–FI12
Forest adaptation as a relatively low policy priority	26	R1, R2, R5, INV1, GOV1
Native tree species sequestering less carbon	26	FI7–FI9, FI11, FF1, FF2, FF4, FF6, R2, MF1, MF4)
ETS to favour Pine and potentially creating carbon liabilities and adaptation benefits associated with the ETS	26	MF1, MF2, C3, FI1, FI3–FI5, FI9, FI11, FI12, R1–R3, R5, FF1, FF2, FF4, FF5, TUR1

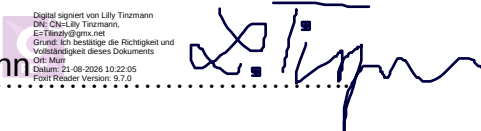
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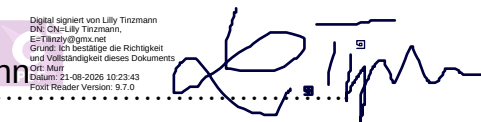
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