



Business ecosystems and sustainability transitions in forest landscapes: A case study in British Columbia, Canada

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Received: 22 January 2024 / Accepted: 28 August 2025
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Abstract

Empirical understanding of sustainability transitions in forestry offers unexplored and important insights into how change happens in forest landscapes. In British Columbia, Canada, the provincial government is taking steps to transform the way forests contribute to societal, environmental, and economic value. Policy reforms aim to support local stewardship and enterprises for a more *diverse, competitive, and innovative* forest sector. We explore the ability and agency of landscape actors to realize this change. Focusing on the Quesnel forest landscape, we use a business ecosystem framework to identify collaboration networks and value sharing mechanisms at the landscape-scale. Results from key informant interviews indicate that high-volume, reliable, efficient, integrated, low-cost wood products remain the primary value-proposition of the Quesnel forestry network. However, shared values are shifting towards resilience, reconciliation, and partnerships. Regional forestry actors are highly interdependent, yielding many economic and environmental benefits but reducing the network's dynamic ability to deliver upon these diversified values. Provincial policy is creating space for regional actors to drive transformative change but diminished agency, characterized by uncertainty and disempowered leadership, is hindering action. Our findings suggest that shared values of business ecosystems can mobilize agency and shift value-propositions towards sustainability transitions, but progress may be limited by deep systemic barriers. Continued progress towards BC's sustainability transition may require intermediate steps focused on aligning values, restoring trust, and clearing regulatory obstacles for long-term change. Wildfire resiliency is emerging as an opportunity space for leveraging the strengths of the Quesnel forestry network, reconciling local and provincial objectives, and shaping forestry systems that are reflective of more inclusive value-sets. Carefully navigated, these pathways can support improvements in the public's understanding and perception of forestry.

Keywords Forestry · Forest Landscape · Sustainability Transitions · Business Ecosystems · Wildfire Resilience · British Columbia · Canada

1 Introduction

Forests are central to sustainability transitions. Globally, forests provide important contributions to climate change mitigation and adaptation, the maintenance of terrestrial biodiversity, and goods and services that sustain ecosystems and economies (Berkes & Davidson-Hunt, 2006; Myers, 1997; Watson et al., 2018). In jurisdictions with high forest cover, decisions on how forests should contribute to sustainability transitions and through what processes requires carefully navigating broad societal values, including the rights of Indigenous Peoples, reducing inequality, and addressing the climate and biodiversity crises (Meadowcroft, 2011; N  yh   & Wallius, 2023). In regional settings where economies and livelihoods are historically tied to forest ecosystems, these decisions have far-reaching and long-term consequences for social-ecological resilience (Halonen et al., 2022; Turner et al., 2003). Transformative efforts to improve sustainability, mitigate climate impacts, and diversify values in forestry systems demand structural and systemic changes across different scales (Biermann et al., 2012; Scoones, 2016). Policies and institutions can drive these changes but must also be cognizant of fostering agency and capacities for sustainability transitions at the local level (Collen et al., 2016; Delabre et al., 2020; Hansen & Coenen, 2015; Seyfang & Smith, 2007).

In British Columbia (BC), Canada, forests cover about two-thirds of the province, roughly 60 million hectares. Approximately 94% of forests are considered Crown land, under the statutory control of the provincial government. As a province with a long and complex history of cultural and economic ties to forests, including unceded First Nations territory, decisions over forests in BC have been political and contested. Industrial logging developed to serve US commodity markets have dominated values from forests, deterring investments in knowledge and innovation (Porter & Martin, 2000; Roche & Gaston, 2001). Local communities, businesses, and First Nations have continually expressed frustration at the narrow prioritization of timber and financial values from forests (Riggs et al., 2023b). Attempts to radically transform forestry have resulted in gradual progress towards sustainability but have historically failed to address underlying tensions in how and by whom forests are valued (Cashore, 2011; Earley, 2023; Howlett et al., 2009). In the past five years, converging crises have renewed enthusiasm for change, and foundations for systems-wide change are slowly falling into place (Copes-Gerbitz et al., 2022; Devisscher et al., 2021; Smith & Bulkan, 2021). Some of these foundations include legislation to recognise the rights of Indigenous Peoples, civil society movements to protect ancient forest ecosystems, and urgent measures to prevent catastrophic wildfires (Gorley & Merkel, 2020; Government of British Columbia, 2021; Nikolakis & Roberts, 2022). In response to these events and deeper economic and environmental issues, the provincial government of British Columbia announced intentions to transform the forest sector, laying out *“a vision for a forest sector that is diverse, competitive, and focused on sustainability”* (Government of British Columbia, 2021). The 2021 intentions paper, titled *Modernizing Forest Policy in BC*, attempts to guide provincial-wide policy and regulatory changes to create more inclusive sustainable forestry systems. However, the local pathways to realizing this transition at the landscape-scale remains unclear.

The provincial government’s vision for the BC forest sector aligns with the United Nations Sustainable Development Goals, reflecting global calls for just and equitable transformations to sustainability (Sayer et al., 2019; United Nations, 2023). While deep structural

changes are needed to meet these goals, shifting societal values and recognition of Indigenous Peoples present opportunities to catalyze change. Forestry in BC comprises complex value chains, influenced by global markets, provincial regulations, tenure, and local preferences and environmental conditions. In forest landscapes, the actors involved in translating benefits from forest to society, resemble an ecosystem – where businesses, First Nations, governments, and stakeholders are interlinked and contribute to social, economic, and environmental values (Bixler, 2014; Grace et al., 2018). These interactions can be referred to as a business ecosystem (Kapoor, 2018). Business ecosystems have an essential role in realizing sustainability transitions – defined here as a long-term, multi-dimensional and fundamental transformation to more sustainable modes of production and consumption (Derks et al., 2022; Markard et al., 2012). Yet knowledge gaps exist in empirical understanding of how business ecosystems can shape sustainability transitions, and the implications for complex sectors such as forestry (Aagaard et al., 2021a; Falcone et al., 2020; Halonen et al., 2022; Näyhä & Wallius, 2023; Pülzl et al., 2017).

To better identify landscape-scale pathways towards more inclusive and sustainable forestry systems in BC, we take a business ecosystem approach to analyze the values of key forestry actors and their perspectives on barriers and opportunities to transition. Focusing on the Quesnel landscape in the Northern Cariboo region, we ask (1) what are the existing and evolving values in the forestry network? And (2) what steps can the Quesnel forestry network take to realize BC's transition towards a more sustainability-focused forest sector? The objectives of this research are twofold. Firstly, we aim to provide tangible insights to forestry actors in BC seeking to support this transition. Secondly, we aim to contribute to empirical case studies of business ecosystems as agents of change in sustainability transitions, specifically for forest systems. Together, these objectives seek to close knowledge gaps on how forest landscape actors can increase and diversify the value proposition of forests as perceived by society, and advance understanding of the role of business ecosystems in sustainability transitions. Recognition of the multiple co-existing values of forests is a globally significant challenge for sustainable and inclusive natural resource governance (IPBES, 2022). Our study offers empirical and theoretical insights for research confronting this challenge.

In the next section, we review emerging understanding of sustainability transitions and business ecosystems in relation to forest landscapes. We then provide background on BC's forestry sector sustainability transition and discuss the case study of Quesnel, BC. We conclude with globally relevant insights on the importance of aligning values for intermediary steps towards sustainable forest systems.

2 Business ecosystems for sustainability transitions

Sustainability transitions characterize fundamental transformations across political, social, and technological systems towards more sustainable modes of production and consumption (Markard et al., 2012). Understanding the nature of these transformations – and how to facilitate them – is now a growing field of global interdisciplinary research (Frantzeskaki et al., 2012; Hansen & Coenen, 2015; Köhler et al., 2019; Loorbach et al., 2017; Raj et al., 2022; Rogge & Reichardt, 2016). Sustainability problems are pervasive; there can be no single approach to diagnosis or transformation. Changes that lead to more sustainable systems

are often non-linear and polycentric – they are difficult to plan or control at scale (Edmondson et al., 2019; Kemp et al., 2007). Different analytical perspectives have helped to enrich knowledge on the human drivers of transformations (Loorbach et al., 2017; Patterson et al., 2017; Scoones et al., 2020; Turnheim et al., 2015). In this study, we are interested in understanding the emergence of transitions across scales; how enabling conditions interact with structural and systemic changes (Lambin et al., 2020; Scoones et al., 2020). Within the sustainability transitions literature, a large body of work exists framing sustainability transitions according to a Multi-Level Perspective (MLP), in which different levels of change are described as niche, regime, and landscape (Geels, 2002; Geels & Schot, 2007). In this paper, we focus our attention on interactions between the provincial and regional (local) level in BC, using the term landscape to describe a region, rather than a macro-level of analysis.

Like biological ecosystems, the concept of a business ecosystem stems from understanding that companies interact with diverse actors, evolve to develop new capabilities, and work cooperatively and competitively to meet their goals (Moore, 1993). While very few studies of business ecosystems focus on forest-related industries (Menghwani et al., 2023; Viholainen et al., 2021; Weiss et al., 2021), the concept has been widely applied across different sectors to show how multiple types of actors – business partners, institutions, supporting organizations – are important to value creation (Järvi & Kortelainen, 2017; Mäkinen & Dedehayir, 2012; Yoon et al., 2022). Sako (2018) distinguishes business ecosystems from clusters and organized networks, noting that business ecosystems are self-sustaining and governing, evolving intrinsically over time. Business ecosystems may be intentionally setup with narrowly defined value (i.e. electric vehicles) or may emerge to co-create a range of values through interdependencies and complementarities (Kapoor, 2018). According to Thomas and Autio (2012), business ecosystems require institutional stability, such that coordination and collective performance are guided by shared norms and trust between actors. Adaptation is critical to the survival and performance of ecosystems, including capabilities to respond to exogenous drivers of change and decisions made by other firms within the system (Pierce, 2009).

To date, much of the focus of sustainability transitions has been on processes of innovation within socio-technical systems, with less attention given to social-ecological systems (Avelino et al., 2024; Loorbach et al., 2017). There has also been growing interest in power and agency in accelerating transitions at different spatial scales, particularly within the MLP framework (Avelino, 2017; Geels, 2014; Köhler et al., 2019). To expand empirical understanding of these domains, business ecosystems offer a useful method for considering how landscape actors can operate as collective agents in driving or inhibiting sustainability transitions (Bidmon & Knab, 2018; Lazarevic et al., 2019; Planko & Cramer, 2021; Speich & Ulli-Beer, 2023). Changing value-propositions of business ecosystems influence societal behaviours and institutions through the development of regulations or markets, influencing discourses, and shifting cultural values (Aagaard et al., 2021a; Köhler et al., 2019). Understanding these dynamics at the regional or landscape scale requires close attention to change agency; the ability of actors (individually and collectively) to shape trajectories of change (Grillitsch & Sotarauta, 2020). Applied to business ecosystems, agency exists in a collective form, where landscape actors are empowered to shape a process that ‘places their own concerns on the sustainability agenda’ (Koistinen et al., 2018). If business ecosystems are to facilitate sustainability transitions, they must have the resources, knowledge, and agency to break the status quo, either through establishing new institutions and innovations (struc-

tural and systemic approaches), or through local leadership that mobilizes collective action (enabling approach) (Grillitsch & Sotarauta, 2020; Scoones et al., 2020). Examining these pathways can help to better understand how agency is formed and exercised in sustainability transitions to enact change (Koistinen et al., 2018).

Past discussions on sustainability transitions have often noted a lack of detailed understanding on how agency and abilities are held, shared, or transferred among local actors driving change (Avelino, 2017; Geels, 2011; Shove & Walker, 2007). In the case study that follows, we attempt to close this gap by examining the capability of the Quesnel forestry business ecosystem to operationalize the aspirations behind BC provincial government's sustainability transition, and the multi-scalar factors that influence trajectories of change. We focus on the shared values of the business ecosystem (values shared by people in groups and/or values that inform shared identity of a particular group), the value proposition of the business ecosystem (benefits to customers and stakeholders), and how these values influence (and are influenced by) BC's forestry sector sustainability transition (Aagaard et al., 2021b; Pascual et al., 2017). We draw on the notion of an 'opportunity space' (Grillitsch & Sotarauta, 2020) for how business ecosystems can mobilize change agency in sustainability transitions. By focusing on values and change agency at the landscape-scale, we also highlight the broader political, social, environmental, and economic contexts and historical legacies that are critical in setting the conditions for change.

2.1 Case study: navigating sustainability in the forest sector of British Columbia

For thousands of years, First Nations in BC have engaged in forest stewardship, shaping how forests provide for people and nature. Industrial forestry, introduced by colonial economic regimes, has been a core part of BC's provincial economy since it first began in the mid 19th century. Initially developed as part of economic interests to increase accessibility and resource extraction, the sustainability of forest industry was first publicly questioned at the turn of the 20th century. Concern over unsustainable exploitation and industry dominance have surfaced in five Royal Commissions, each time leading to incremental improvements towards sustainable forest management and addressing public concerns over logging practices without major disruptions to the industry (Cashore, 2011; Mitchell-Banks, 2000). In the past 30 years, incremental progress towards sustainability have been interspersed with transformative events. In the 1990s, tensions over the sustainability of the forest sector erupted with 'The War in the Woods' – a series of protests and blockades to prevent industrial logging in Clayoquot Sound. The conflict ended with a collaborative land use agreement that restricted logging to maintain the ecological integrity of the landscape – a milestone for collaborative ecosystem-based management (Butt & McMillan, 2009). Soon after in interior BC, the Mountain Pine Beetle (MPB) outbreak killed millions of hectares of pine trees over two decades, forcing rapid harvesting to salvage dead wood and prevent further spread (Dhar et al., 2016). More recently, the province (including many areas affected by MPB) has suffered catastrophic wildfires, drawing attention to the negative ecological consequences of fire prevention and suppression (Copes-Gerbitz et al., 2022; Parisien et al., 2023). Each of these events have elevated societal interests over what sustainability and resilience means for BC forests, and who should decide what happens to them (Devisscher et al., 2021). Governments, communities, and industry have slowly recognised that First Nations need a stronger voices in forest governance, who despite their longstanding claims

to unceded territory, have been largely excluded from forest and land-use decisions (Caverley et al., 2020; Wyatt, 2008).

The past 30 years of societal and ecological disruption to BC's forests have culminated in three significant policy initiatives to drive the forest sector's sustainability transition. In 2019, the Declaration on the Rights of Indigenous Peoples Act (DRIPA) was passed by the provincial government (Government of British Columbia, 2022). Intended as a framework for reconciliation across all sectors, DRIPA established pathways for bringing legislation into alignment with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and open new opportunities for Indigenous governing bodies. In 2020, the government released *A New Future For Old Forests: A Strategic Review of How British Columbia Manages for Old Forests Within its Ancient Ecosystems*, which led to logging deferrals of over 2 million hectares old growth forest across the province (Gorley & Merkel, 2020). Then in 2021, the intention paper, *Modernizing Forest Policy in British Columbia: Setting The Intention and Leading the Forest Sector Transition*, was released followed by amendments to the *Forest and Range Practices Act* (Government of British Columbia, 2021). These recent policy reforms have received widespread media attention, indicative of societal interests in changes to First Nations rights and forest stewardship, although not uniformly shared values (Bennett, 2022; Kveton, 2022; Narwhal, 2023). Together, these policies represent efforts for transformational change in the forest sector towards resilience from fire and pests, old-growth protection, diversified cultural and environmental values, empowered First Nations through rights and stewardship, and diversified forest products through increased opportunities for participation and innovation. These objectives are broadly supported within the sector, but the pace of change combined with the difficult recovery from MPB and fires has caused confusion and uncertainty over what the future holds.

While the forest sector's sustainability transition is largely driven by the provincial government, disruptions are felt deeply across rural communities. Each of these communities have their own vision for sustainable forest landscapes, often comprised of conflicting views amongst stakeholders and individuals. Many municipalities, businesses, and First Nations are taking steps towards reconciliation and wildfire resilience at the local level, including forest stewardship and revenue-sharing. The diversity of local initiatives suggests there is general alignment with the provincial government's aspirations for forest policy. A key tension is that these initiatives are locally driven and do not necessarily fit within the current constraints of provincial policy (Furness et al., 2015; Riggs et al., 2023a; Sutherland et al., 2023). Rural communities have found themselves struggling with this dissonance; eager to increase their agency to drive change towards better social and ecological resilience but struggling to navigate provincial policies and regulations. In the following sections, we examine how these challenges are unfolding in the Quesnel forest landscape, where local forestry actors are searching for new sustainability pathways through a collaborative and multi-level process of change.

3 Study site and methods

This study aims to provide tangible insights to how landscape actors can support an inclusive sustainability transition in the forestry sector of BC. In doing so, it seeks to close knowledge gaps on empirical understanding of how business ecosystems can operationalize

sustainability transitions in complex social-ecological ecosystems. To meet these objectives, we use an exploratory case study analysis (Yin, 2009). A case study approach allows for multiple levels of analysis within a single study, drawing on rich descriptions to uncover relationships (Eisenhardt, 1989). An exploratory case study analysis can be used to generate insights into under-investigated phenomenon, developing propositions for further study (Yin, 2009). The lack of empirical studies on business ecosystems and lack of documented experiences of landscape-actors in navigating BC forestry's sustainability transition makes this appropriate choice. The Quesnel forest landscape was selected for its position within the BC forestry context – a town with a long history of forestry, direct experience with MPB and wildfires, and locally-driven efforts to restore social-ecological resilience to the region. The term sustainability transition is used to describe the forestry sector's diversification from a timber-centric and commodity lumber oriented industry, towards a sector that is diverse (multiple and different sized enterprises, products and management values), innovative, and resilient against ecological and economic shocks.

The municipality of Quesnel is located in the Cariboo Chilcotin District of interior BC, 700 km North of the provincial capital Vancouver. The city is surrounded by the Quesnel Natural Resource District, referred to here as the Quesnel forest landscape. Four First Nations, Lhtako Dene, Nazko, Lhoosk'uz Dene and ?Esdilagh, have territory within the landscape. The population of Quesnel and the surrounding area is 23,000, with just over half of the residents living outside the city. The Cariboo Chilcotin region has a long history of mining, ranching, and forestry, which has shaped much of the current land use and culture. Today, 6 major forestry mills and processing facilities continue to operate within the Quesnel municipality. Like most parts of interior BC, the Quesnel forest landscape was severely impacted by MPB and subsequent wildfires. The 2017 and 2018 wildfire seasons had devastating impacts on the forest and community, mark a turning point in Quesnel's sustainability trajectory. In 2018, the municipal government established the Quesnel Forestry Initiatives Program (FIP) to work with First Nations and stakeholders on improving social-ecological resiliency. As it navigates challenges shared with many other regions across the province, Quesnel has established itself as a learning landscape – a place for exchanging ideas and building partnerships (Riggs et al., 2023). This study is a collaboration between the Vibrant Forest Landscapes Lab at the University of British Columbia Faculty of Forestry and the FIP seeking to understand and build capacity for transdisciplinary science in forest landscapes.

In this paper we draw from qualitative methods, primarily key informant interviews, document analysis, and informal engagement over a four-year period (2019–2023). Key informants were selected based on their involvement in the forest sector as a business, regulator (government), supporting organization (NGOs, associations, universities), and rights-holders (First Nations). Businesses included forest licence-holders, primary and secondary wood manufacturers, and construction businesses using wood materials. Initial participants were selected by the FIP, followed by snowballing sampling, where interviewees recommended informants until a saturation point was reached (Parker et al., 2019). Overall, 32 key informant interviews were conducted in the Quesnel region between June 2021 and July 2023 (Table 1).

The key informant interviews were guided by three questions:

1. How do you describe your business/organization and goals (value proposition)?
2. What are the challenges and opportunities for achieving your organizational goals?
3. What are the assets, capabilities, and interactions that support Quesnel's sustainability transition?

Interview questions were semi-structured, focused on relationships between actors, goals and constraints, and perceptions of opportunities and challenges in transitioning to a forest sector that is more inclusive, diversified, and resilient. Interviews were recorded, transcribed, and thematically coded using NVIVO (QSR International, 2022) according to the guiding questions. The coding process was guided by grounded theory coding, using emergent categories to organize and group initial codes, and then develop broader higher categories (Charmaz, 2014). Core categories were then selected to examine and validate relationships and answer research questions (ibid.).

The document review included content analysis of peer-reviewed literature, media articles and public commentary, government documents, and two key policy documents:

- *A New Future For Old Forests: A Strategic Review of How British Columbia Manages for Old Forests Within its Ancient Ecosystems* (Gorley & Merkel, 2020).
- *Modernizing Forest Policy in British Columbia: Setting The Intention and Leading the Forest Sector Transition* (Government of British Columbia, 2021).

The document review offered broader context and perspectives on the topic that might not have been covered in interviews. It was used to inform and support interviews, as well as validate and triangulate interview findings (Bowen, 2009). Supplementary information was gathered through informal discussions over the four-year period.

From the interviews and document analysis, a visual heuristic of the Quesnel network was created to capture the exchange of tangible and intangible value. The heuristic draws on research methods in network analysis and cognitive mapping, where visualization of networks can assist in investigating meanings attached to relationships and networks (Jaspersen & Stein, 2019; Riggs et al., 2024). In this case study, the heuristic was used to

Table 1 Representation in key informant interviews. Note that interviewees may fit into multiple categories (i.e. licence-holder and industry). For these interviewees we have selected the category that best represents the interviewees position at the time of interview

Representation	Number of interviewees
Government (provincial, First Nations, municipal)	5
Non-government (organizations and researchers)	4
Forest licence holders	8
Primary industry	4
Secondary industry	5
Construction industry	1
Associations and service providers	5
Total	32

convey the complexity and intertwined nature of the business ecosystem, rather than quantify relationships.

4 Results and discussion

4.1 Quesnel's forestry business ecosystem: evolving values

The Quesnel forestry business ecosystem consists of large, medium, and small businesses; government; NGOs; associations; universities; and First Nations actively collaborating for common values across the entire forestry value chain (Fig. 1). Not all actors are situated within the Quesnel landscape, such as NGOs and associations operating provincial-wide and business partnerships outside of the region, illustrating the permeable boundaries of forest landscapes and connectedness of the Quesnel ecosystem. The network has one large industrial company that acts as a keystone firm (Mäkinen & Dedehayir, 2012), providing significant support to smaller firms and connected actors. The complex interdependent network dynamics are described below. The shared values held by actors in the ecosystem influence the value-proposition. Benefit flows span tangible (materials, products) and intangible (expertise, trust) assets. The shared values and the value proposition of the business ecosystem are involving, influenced by the provincial forest sector's sustainability transition, and influencing local efforts to achieve transition goals.

Historically and still today, the principal value created by the Quesnel ecosystem is high-volume, reliable, efficient, low-cost wood products, with integrated systems to reduce waste. Evidence of this long-standing value proposition is seen in interconnectedness of the ecosystem; waste and residual products are developed into new products, processing

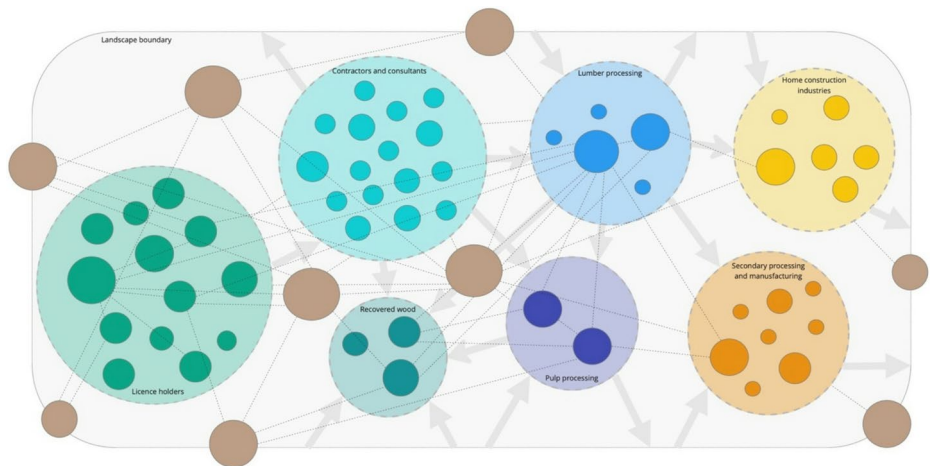


Fig. 1 Visual depiction of the Quesnel forestry business ecosystem. Firms are grouped into different stages of the forestry value chain. Arrows represent predominant material flows. Dotted lines characterize partnerships and intangible benefit flows. Brown nodes represent intermediary actors that do not sit directly within the supply chain but contribute to overall value proposition. As indicated, most intermediary actors operate outside of the Quesnel landscape, providing connections to external actors. The figure is representative of the complex interdependency of the network, including vertical integration and permeable boundaries. It does not capture all interactions

facilities exchange material to maximize value, and commodities (timber, pulp, pellets) dominate the production system. Central to this value-proposition is expertise generated in Quesnel, distributed amongst contractors, consultants, foresters, processing facilities, and trades and converted into tangible assets through technological innovation and forest management. Decades of investments made by large and small companies (i.e. contractors owning machinery) for high-volume production has shaped current skillsets, infrastructure, and forest structures. The business ecosystem is closely entwined with contemporary values of place; influenced by and contributing to the social, economic, and ecological fabric of the region.

Despite historical and cultural legacies, interviews suggest values held by companies have been evolving in recent years, opening new pathways for sustainability through wild-fire management and reconciliation. The fires of 2017/2018 had a significant impact on forests managed by companies on First Nations territory, reducing access to timber and cultural resources. In addition to causing widespread ecological damage, one construction business reported that wildfires disrupted supply chains, working conditions, and costs such as home insurance. Disruptions caused by fire brought ecological resilience into the foreground of forest stewardship. Values held by actors have expanded from maintaining productive forests regional economies to sustaining holistic and inclusive social-ecological resilience. Several actors in the Quesnel ecosystem are involved in wildfire recovery and planning, adjusting management practices to improve the capacity of the landscape to co-exist with fire. Reconciliation was expressed by interviewees as a shift towards community and First Nations partnerships in ways that encouraged genuine trust-building and recognition of rights. Companies interviewed expressed dissatisfaction in the traditional consultation processes mandated by the provincial government. Instead, interviewees spoke of the benefits of establishing partnerships on terms set by First Nations and local communities, going beyond regulatory requirements.

We had to stop, slow down, and listen. We don't consult, we engage.

Evolving shared values towards ecological resilience, reconciliation, and partnerships, and incorporating diverse interests into forestry practices may seem incremental rather than transformative, but they signify a paradigm shift in BC forestry. Emerging shared values are contributing to a shift in the ecosystem value-proposition. While still an integrated system focused high-volume, reliable, efficient, low-cost wood products, there is increasing attention in Quesnel on how to deliver that value through partnerships, ecological resilience, and balancing different land interests. Partnerships are not uniform; some are more advanced in the ways that tenure and right-holders participate in decision-making. But the emerging partnerships reflect societal and structural shifts towards diverse and inclusive forestry, prompting businesses to re-evaluate what sustainability and resilience means for the Quesnel landscape.

We're starting on our own initiative here in Quesnel... Some of the government initiatives that are coming - we're already doing stuff that will set us up so we can meet some of these new desires on how the land is managed.

The Quesnel business ecosystem's expanding value-proposition is representative of changes in the needs and concerns of the broader Quesnel region. By aligning with these emerging regional values, the ecosystem is revealing an opportunity space for mobilizing agency towards sustainability pathways that respond to these values (Grillitsch & Sotarauta, 2020). This hints at the ecosystem's transformative capacity – potential to respond and influence the wider systemic setting through value-proposition, and co-evolving with institutional, discursive, practical, and relational aspects of BC's forestry transition (Beers et al., 2021). While the discursive power of shared values can help to accelerate sustainability transitions, values alone are insufficient in mobilizing change (Arias-Arévalo et al., 2023).

4.2 Characteristics and capabilities: strengths and challenges for a sustainability transition

The network depicted in Fig. 1 illustrates the vertical integration of the forestry industry in BC, historically designed due to high capital costs of pulp and paper facilities, economies of scale, and to enable efficient material and energy use between sawmills and pulp mills. Yet the integration of forestry networks extends far beyond ownership structure. Local contractors conduct services such as timber harvesting, silviculture (tree planting), road construction, and trucking, and entire industries depend on by-products from logging and mills (i.e. pellets and engineered wood products). New tenure-holders benefit from the expertise and abilities cultivated by large companies, and the regional economy is tied to employment in the sector. As stated by one interviewee:

We live and die on what the major's are up to.

Quesnel's highly interdependent forestry ecosystem is a double-edged sword for a sustainability transition. The sense of community is leveraged to share knowledge and resources and improve participation and understanding of forest management – such as support for recent and planned community forests. Partnerships are not just transactional; they create opportunities for companies to consider future expertise and alternative practices to meet evolving values. But the integration and interdependence of the network also reduces its flexibility and capacity for change. In maximising reliability and stability, coordination and cooperation are high but responsiveness to external change is slow and incremental. Interviewees noted the gap in capabilities between small tenure-holders and large companies, creating beneficial relationships, but leaving small tenure-holders vulnerable to shocks. An example is the recent closure of two sawmills, which forced the subsequent closure of a small First Nations logging business:

“Two large scale mills shut down, and another reduced capacity. And then the wild-fires happened. There's a lot of fibre that's not accessible anymore. It has affected the community, after the fires and the downturn in the economy, the logging business we had shut down... only one mill was operating [and] the general log prices at that time were pretty low. ... The logging company went into a situation when it wasn't really profitable anymore”.

In interviews, we learnt that forestry actors are aware of the risks of interdependency but are concerned that the current state of knowledge and abilities limit opportunities for change. Concerns of an aging low-skilled workforce were expressed by multiple interviewees. The profile of the forestry workforce is older, low skilled workers with capital tied into equipment suited traditional forestry practices, unlikely to seize opportunities for new, high-skilled, innovative forestry. Similar challenges exist for commodity mills, which have been characterized as rigid and conservative, with large capital investments in vertically integrated industries limiting flexibility (Pinkerton & Benner, 2013). The Quesnel network is skewed towards upstream activities and commodities, with fewer connections to and presence of smaller enterprises involved in secondary wood manufacturing. Many interviewees commented that Quesnel needs a mid-size high value enterprise (such prefabricated housing) that could use sawmill products and feed into growing housing construction markets. However, one government representative noted the challenge of planning for change without sufficient knowledge of the forest and its potential.

We've had a lot of queries from different partners and Indigenous communities on what are our opportunities... We're in a place now where we need better information and better analysis of what's on the land-base so we can support those business cases. Having that accurate information to give us a better sense of what's actually on the land base would go a long way in helping some of that planning.

The limitations in knowledge and abilities in the Quesnel network offer important empirical insights into constraints of business ecosystems to bring about transitions. In theory, researchers claim that a business ecosystem should organize itself to develop and source systems capabilities, incurring costs through individual business models (Lazarevic et al., 2019; Planko & Cramer, 2021). Yet in practice, developing the capabilities needed are not simply a matter of external sourcing or collective contribution, but require complex structural change. For example, an aging workforce averse to innovation and risk is the product of decades of forest policy, practice, and education (Simard, 2021). This reinforces the role of the institutional, technological, and economic environment in supporting or hindering capabilities for change (Avelino et al., 2016; Grillitsch & Sotarauta, 2020).

4.3 Change agency: enablers and constraints

The provincial government has introduced several initiatives to enable the forest sector's sustainability transition (Government of British Columbia, 2023). However, we found two dominant points of concern among interviewees that demonstrate institutional constraints on Quesnel's agency to realize these opportunities: (1) uncertainty over the implementation of government's vision for sector (2) lack of investment in decentralized leadership to guide the transition.

Despite intentions to guide a sustainable and productive forestry industry, policy reforms over the past four years have caused uncertainty in the viability of the forest industry. Interviewees shared views on conflicting and incohesive policy objectives, such as unchanged legislated practices allowing companies to continue planting forests that are vulnerable to fire, and lack of regulatory support for monetizing non-timber values and improved silvicultural practices. There seemed to be a pervasive lack of trust— not at a personal level, but

at a provincial level tied to a long history of politics and conflict. Uncertainty in what the future holds, and how to prepare for it, is limiting progress towards Quesnel's sustainability transition.

The promises are there with this latest government, but its slow to react - it's just the nature of the beast. You don't know if you're going to be able to take advantage of it... when you don't know what to do, you don't do anything.

There was also concern amongst interviewees that institutional silos and a lack of investment in decentralized leadership and capacity has inhibited communication channels. The problem of silos was raised as an issue within different governing bodies – that policies and initiatives are less effective because of a lack of integrated planning. Several interviewees expressed concerns that local government offices are understaffed, restricted, and lack information and resources, inhibiting their capacity to provide support and vision. First Nations are also overburdened; forestry is one of many increasing demands on Nation staff time. Lack of resources and empowered leaders means Quesnel is limited in their capability to capitalize on the initiatives presented by the provincial government.

Current institutional constraints raise questions over the expectations of the new Forest Landscape Planning (FLP) process. The FLP process, still in its pilot phase at the time of this study, aims to replace existing Forest Stewardship Plans (FSPs), directly incorporating local values into forestry-related decisions through a multi-stakeholder forum. The development of FLPs is expected to take 4–5 years, with time dedicated upfront in the development process to build cohesion and consensus on stewardship values. As several studies have shown, multi-stakeholder process are complicated and slow, especially when colonial and extractive legacies are still present (Larson et al., 2022; Rodriguez & Barletti, 2021). The Quesnel FLP is grappling with this challenge: how to achieve meaningful engagement in a way that leads to tangible objectives for land management. There is concern that the FLP is becoming an all-encompassing platform to deal with concerns, which while important, risks drawing attention away from other urgent issues that might require alternative solutions.

It's become a catch-all... With the lack of staff at the ministry it's preferable to say the FLP is going to handle everything. It's preventing more specific conversations happening outside the FLP. If the FLP wasn't happening, would we be having more meaningful conversations about stocking standards?

Many have argued this form of tactical planning is overdue in BC, and policy reform has created a window of opportunity (Forest Practices Board, 2019). However, recurring concerns of lack of collective capability in Quesnel raise the question of whether actors are ready to effectively utilize this platform. Without detailed knowledge of the land-base, high-skilled workers and machinery for low-impact harvesting, and negligible local options for forest products other than sawlogs, the FLP process is limited in the determination of tangible pathways for realizing sustainability and resiliency.

Inability to benefit from new institutional platforms such as the FLP or funding available to local governments, demonstrates that even if institutions are supportive, alignment of interests is not sufficient for business ecosystems to carry out systems-level change. Notably, BC forestry is still early in its transition, with the intentions policy paper only released

in 2021. Uncertainty can be navigated, but it cannot be removed. Stirling et al. (2023) notes the risk in simplifying sustainability transitions as linear monolithic pathways, which can ultimately undermine authentic progress. Thus, while the Quesnel ecosystem may find challenges in mobilizing systemic change towards a diverse, innovative, and resilient forest sector, there may be other transition dimensions and outcomes that unfold. We explore these in the next section.

4.4 Wildfire resiliency as a pathway forward

The shared vision of improved ecological resiliency and reconciliation is widely held in Quesnel, but hampered by lack of capabilities, characterized by lack of available knowledge and skills and empowered leadership (Fig. 2). Interviewees were keenly aware of these challenges yet conveyed an urgent need to make progress, proposing that the shared value of wildfire resilience could be a way to achieve broader economic, ecological, and cultural outcomes. Prior to colonial settlement, fire played an important role in the resilience and health of forest ecosystems and people on the lands that are now British Columbia. Fire suppression and exclusion of First Nations in the 20th century left a legacy that society, government, and industry are struggling to grapple with. The consequences of fire suppression and current wildfire risks are well documented (Brookes et al., 2021; Parisien et al., 2023). The potential for the forestry sector to contribute to restoring a healthy relationship with forests is still emerging (Copes-Gerbitz et al., 2022; Dickson-Hoyle et al., 2023). As a shared value held by all actors that is visible through concrete actions, wildfire resilience represents an ‘opportunity space’ for mobilizing change agency (Grillitsch & Sotarauta, 2020). In Quesnel, interest in and action towards wildfire resilience is actor specific (aligned with competencies and values of individuals and organizations), region-specific (responds

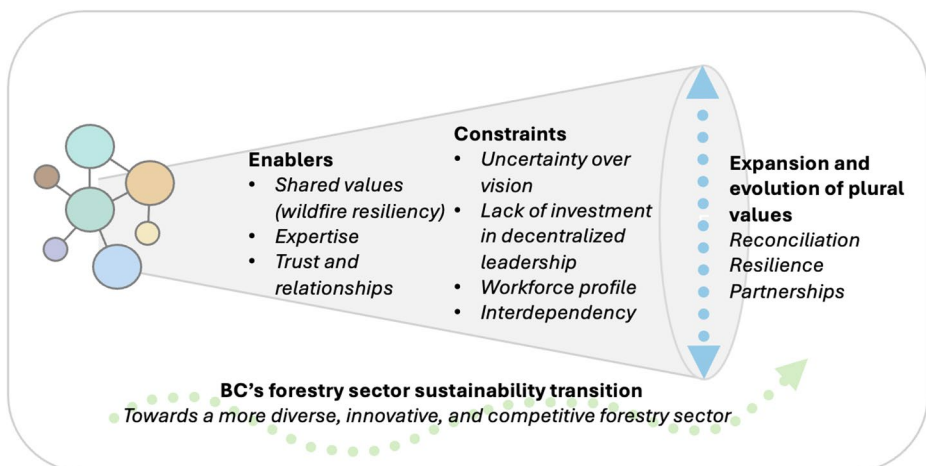


Fig. 2 Enablers and constraints to BC's forestry sector sustainability transition. The expansion of values to incorporate reconciliation, resilience, and partnerships can help to meet the transition goals of becoming a more diverse, innovative, and competitive forestry sector. Collective action to meet values and goals requires overcoming constraints and recognising opportunity spaces, such as the shared value of wildfire resilience

to regional experiences and geography), and time-specific (reflects current societal and provincial interests) (Grillitsch et al., 2024). Improving wildfire resiliency also aligns with BC's vision for a diverse, competitive, and innovative forest sector. For the business ecosystem, engaging in wildfire resilience could function as an intermediate step towards the goals of BC's sustainability transition, as well as developing capability and agency for the regional social-ecological resilience (Fig. 2).

In interviews we learnt of range of co-benefits resulting from fire management. We also learnt of benefits that are yet to accrue, held back by regulatory constraints and risk. With settlements close to forests, First Nations in Quesnel are engaged in cultural stewardship initiatives to reduce wildfire risk, including fuel treatments and prescribed burning. According to interviews and supported by recent studies, when organized through inclusive partnerships, wildfire treatments and other land-based activities offer opportunities for co-learning, incorporating First Nation values into stewardship practices and building capacity (Dickson-Hoyle et al., 2022). Yet many of these initiatives continue to be top-down, rather than responsive to local values.

There's a lot of programs that are available but there's only a handful we can access because of capacity limitations. Even when you can do it there are always deliverables that are set by the Ministry... That's a big limitation because it's hard to get people enthused about something they didn't want to achieve.

There is significant potential to better incorporate fire management into silviculture and harvesting. Considerations of future wildfire risk in restoration policies are inadequate (Lieffers et al., 2020). Intermediate harvesting and thinning of trees reduces the density of forests, with potential for increased wildlife habitat and plant diversity, recreation, wildfire risk reduction and contributing to available timber for harvesting (Devisscher et al., 2021; Franklin et al., 2019; Griess et al., 2019; Simard et al., 2021). Despite thinning being a common practice in other countries, the forestry sector in BC has been hesitant to practice thinning, resulting in a lack of understanding and investment in skills and machinery. Gradual awareness of benefits is growing, opening pathways for change:

Once you've done some thinning, and you can show people what it looks like, then the doubters disappear... I tried 8 years ago and it was a non-starter. Once people see it, it makes sense. ... if it's just the idea they don't understand what it is.

Interviewees emphasized that wildfire resiliency requires a holistic and collective approach to stewardship, silviculture, and harvesting. As highlighted by one interviewee, partnerships can ensure that intermediate harvesting is not confined to areas where it is most profitable, but with broader consideration of the values on the landscape. NGOs and associations have a role in sharing knowledge and reducing risks; projects funded by Forest Enhancement Society of BC provide information on ecological health after fuel treatments, building a shared evidence-base. Smaller tenures provide opportunities to trial approaches that can be scaled. For actors in the business ecosystem that depend on waste products, such as the bio-mass sector, wildfire mitigation is seen as a significant opportunity to achieve provincial goals of diversification.

The Ministry is starting to view wildfire mitigation as resilience against wildfire as a pre-treatment for forests... There's a whole host of innovative types of projects. Policy is not close to where needs to be in order to help to facilitate project likes that, so that needs to catch up... Evolving policy and evolving forest operations, there's a huge opportunity there. The single largest opportunity facing the biomass sector is this movement to creating more resiliency in our forests and dealing with low grade wood.

As a shared value, wildfire resilience creates common ground for actors to align actions while acknowledging plurality in worldviews and practices. Grillitsch et al. (2024) observe this same plurality in opportunity spaces – noting variance in how actors engage in change processes that cannot be predicted based on regional conditions. The different approaches and intentions in wildfire resilience raised by interviewees demonstrate this variance. For example, interviewees shared emerging practices to improve wildfire resilience in forestry operations that include cultural burning, increase the quality and availability of timber through intermediate harvesting, and diversifying tree species. These practices are often promoted through different worldviews, tangled up in polarized debates on forest production and conservation. Yet under the shared value of wildfire resilience, these practices are considered complementary actions towards tangible outcomes.

In BC's sustainability transition, wildfire resilience can be described as value-centred leverage point (Pascual et al., 2023), in which values are strategically aligned but societal structures are not completely disrupted. This may allow for more a more gradual non-linear process change, in which the business ecosystem engages in strategic interventions that respond to sustainability problems, reducing the risks of putting all resources into a single approach.

We have to be careful about painting everything with the same brush, it's more about doing a variety of things rather than finding a new silver bullet that's going to solve everything for us.

Aligning the actions of the Quesnel network under the shared value of wildfire resilience may also help to expand societal and industry discourse on what a sustainability transition in the forestry sector is comprised of. As shown by Avelino (2017), the introduction of policies designed to transition sectors can have considerable disempowering effects in operational levels. In forestry and especially in BC, the sustainability discourse is contentious, susceptible to historical legacies of conflict, polarization, and tribalism. Shifting attention to wildfire resilience might create a less politicised space where knowledge is held by more diverse actors, opening exchange and learning. At a time when the forest sector in central in the public dialogue on fire risk and regional economies, wildfire resilience could offer one way to break-down silos, raise public awareness of the complexity of forest ecosystems, and strengthen coalitions for change. The Forest Practices Board, BC's independent forestry auditor, recently declared *“bold and immediate action is required by the provincial government to align policies and programs across all levels of government with a vision of landscape resilience and human co-existence with fire”* (Forest Practices Board, 2023). Proactive interventions that target institutional and regulatory frameworks and access to education and training are likely to yield benefits beyond fire management, providing a basis for future stewardship of land for diverse values.

5 Conclusion

Empirical research on how business ecosystems can drive or participate in sustainability transitions is still emerging. We have demonstrated that in forest landscapes, assessing business ecosystems can be a useful approach to understanding capabilities and change agency for responding to shared values. We propose that shared values can enhance a business ecosystem's value proposition by creating new value propositions and discourses that align with and shape sustainability transition pathways. However, business ecosystems also sit within, and can be constrained by broader institutional and macro-economic conditions (Lieffers et al., 2020; Mitchell et al., 2010; Riggs et al., 2023a). The evolving shared values of the Quesnel forestry network align with BC's shift towards a more inclusive, competitive, and innovative forest sector. Actors participate in collective processes for change but feel constrained by a lack of knowledge, capabilities, and empowered leadership. Despite provincial government efforts to create enabling conditions, uncertainty and lack of trust caused by ambitious and incohesive policy objectives have reduced the agency of local actors to pursue sustainability goals. Wildfire resilience offers an opportunity space for navigating these barriers, empowering landscape actors to achieve progress towards goals.

The findings of this study offer guidance for researchers, decision-makers and stakeholders seeking to accelerate sustainability transitions in complex social-ecological systems. Researchers can support the identification of shared values at the landscape-scale, enabling stakeholders to mobilize collective agency towards actions that respond to these values. Appropriate framing of these values can allow actors to side-step polarization and conflict and develop a shared discourse – a longstanding challenge in forest landscapes (Lucas & Warman, 2018). For decision-makers, addressing the capability and agency limitations in operationalizing sustainability transitions requires careful consideration in policy settings (Bull et al., 2018). As demonstrated by this study, researchers can use the business ecosystem framework to analyse enablers and barriers of capability, informing policy pathways. The BC case study shows that despite aligned intentions between provincial and landscape actors, current efforts are insufficient to grapple with underlying barriers to the transition. This points to a need for deeper systemic analysis of the transition barriers and pathways to develop targeted interventions and support (Moallemi et al., 2022). Future research that documents how policy reforms unfold and interact with landscape-based business ecosystems over a longer period of time can help to provide greater insights into specific actions that strengthen agency and capabilities.

In forest landscapes, sustainability transition pathways are closely entwined with cultural, political, and economic legacies that underpin current capabilities, knowledge, and leadership. Tensions between readiness to change and lack of dynamism are reflective of global experiences of transformations in forestry (Hertog et al., 2022). This study suggests that exploring pathways that bridge values, re-frame challenges, and allow for diverse visions may help to manage and overcome the difficulties of change (Pascual et al., 2023; Scoones et al., 2020). The urgency to improve resilience in forest landscapes, such as wildfire in the case study of Quesnel, require actions across regulatory, market, and stewardship domains. Rather than fuel polarization, concrete and shared objectives such as wildfire resilience have the potential to open possibilities for change, unlocking crucial regulatory barriers to resilient stewardship, silviculture, and harvesting practices. Increasing and diversifying the

value proposition of forests will require society to grapple with the complexity of forestry systems, re-positioning multi-functionality as an opportunity for change.

Acknowledgements This paper draws from the work of many individuals seeking positive change in their community. We are especially thankful to Adinda Herdianti and Emilio Valeri for data collection. Thank you to the Quesnel Forestry Initiatives Program for enabling and guiding this research. We are grateful to those who shared their time and stories through interviews, field visits, hosting students, and joining discussions and activities. We acknowledge the traditional, ancestral, and unceded lands of the Lhtako Dene, Nazko, Lhoosk'uz Dene and ?Esdilagh First Nations. This research is funded by a grant from the Social Sciences and Humanities Research Council of Canada (SSHRC).

Author contributions All authors contributed to the study conception and design. The first draft of the manuscript was written by Rebecca Riggs and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open access funding provided by CSIRO Library Services. This research is funded by a grant from the Social Sciences and Humanities Research Council of Canada (SSHRC). Competing interests: The authors have no competing interests to declare that are relevant to the content of this article. Compliance with Ethical Standards: Ethics approval was provided by The University of British Columbia Behavioural Research Ethics Board (H19-01864).

Data availability Data will be made available on reasonable request.

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