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Subject: Urban density and the urban forest: How well are cities balancing them in the context of climate change? - ScienceDirect

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Cities

Urban density and the urban forest: How well are cities balancing them in the context of climate change?

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Highlights

- The study is among the first attempts to explore policy interactions on climate action, urban planning, and urban forest.

- Semi-structured interviews were conducted with key informants with relevant expertise in cities of Metro Vancouver, Canada.

- Results revealed key trade-offs and synergies among policies and practices, especially in development and infrastructure.

- Connections between trade-offs and synergies suggest opportunities for compact, climate-proofed, and green cities.

Abstract

Urban forests are gaining recognition as a nature-based solution to <u>climate change</u> and other social-environmental issues in cities. Yet, the integration of urban forests may conflict with other climate measures such as urban <u>densification</u>, which may create hostile growing conditions for trees and lead to tree decline or loss. While previous studies have identified conflicts between <u>densification</u> and urban forests, there is a lack of research mapping the relationships among climate action, urban planning, and urban forest policies. This study involved semi-structured interviews with 14 key informants in Metro Vancouver, Canada, a rapidly-densifying region.

Twenty-six trade-offs and 24 synergies were identified in five areas/sectors, such as (re)development and infrastructure. While strategic policies often highlighted synergies, policy implementation processes and outcomes often encountered trade-offs due to factors such as limited budgets and low political priority. Notably, most trade-offs and synergies were found in the same areas - (re)development and infrastructure - and shared the same contributing factors, such as political priority of <u>urban forestry</u>, suggesting areas of opportunity to transform trade-offs into synergies through appropriate planning and monitoring. The study also highlighted the need for further research on the interactions and impacts among municipal policies for more effective implementation and outcomes.

Introduction

Cities play a unique and essential role in the context of climate change, not only because of their significant share of global greenhouse gas (GHG) emissions but also for their jurisdiction to manage the most carbon-intensive sectors, such as land use, energy, buildings, and transportation (Bulkeley et al., 2011; Gurney et al., 2015; Rosenzweig et al., 2010). Many cities have made emission reduction pledges and have introduced climate policies to guide the planning and implementation of local climate action (Rosenzweig et al., 2010). As of 2020, over 980 cities and regions globally have promised to take at least one climate action, such as adopting the target to become carbon neutral or transform to 100% renewable energy (ICLEI, 2020).

Urban forests are increasingly recognized as a nature-based solution to climate change issues in cities (Ferrini et al., 2017). Comprised of trees and associated vegetation in cities, urban forests can sequester and store atmospheric carbon, provide shade (Aminipouri et al., 2019), help manage stormwater, reduce building energy usage, enhance urban biodiversity, and provide a wide range of other environmental, social, and economic values (Endreny, 2018; Nesbitt et al., 2017). These values and benefits are crucial for both climate change mitigation and adaptation, as well as enhancing urban livability and supporting sustainable development. Thus, many cities have introduced urban forest specific policies (e.g. city-wide strategic plans or rule-based regulations) and in some cases integrated them with existing climate and sustainability policy frameworks (Cheng et al., 2021; Conway & Urbani, 2007; Ordóñez & Duinker, 2013).

However, the integration of urban forestry into climate and planning policies may unintentionally conflict with other climate goals and actions. For example, densification (or "the compact city approach"), a common action in cities' climate policies for walkability, energy efficiency, and various other environmental and social benefits, can adversely impact urban forests and green space (Burton, 2000; Haaland & Konijnendijk van den Bosch, 2015, p. 760). As more and more cities start to integrate urban forests in their climate and urban planning policies and practices, there is pressing need to thoroughly understand the interactions among these policies and processes and the potential implications on policy outcomes.

This study is one of the first few attempts that aims to systematically explore relationships among policies relating to climate action, climate-focused urban planning, and urban forestry. It seeks to contribute to existing building blocks of theoretical frameworks of public policy interactions within these three interconnected domains. Through examining the unintentional and undiscovered interactions (especially trade-offs), the study aims to provide new evidence to enhance understanding of how these policies interact and inform more coherent and synergistic policymaking and implementation. By conducting a series of semi-structured interviews with experts from municipalities in Metro Vancouver, British Columbia, Canada, the study addressed the following research questions:

1. What are potential trade-offs and synergies among policies related to climate action, including climate-focused urban planning, and urban forestry?

2. What are the potential solutions (i.e. policies, programs, or initiatives) for dense or densifying cities to resolve or avoid trade-offs among the aforementioned policies?

Climate change, cities, and urban forests are three complex but interconnected topics that are essential to consider in enhancing climate resilience, ecological health, and livability of a city. Cities play a significant role in climate change mitigation and adaptation (Jenkins et al., 2014; Mi et al., 2019; Stevens & Senbel, 2017). Since the 1990s, an increasing number of cities have acted to combat climate change (Sethi et al., 2020). Numerous actions have been implemented, such as developing and switching to renewable energy, increasing densities of infrastructure and population, introducing disaster preparedness plans and stormwater management plans, and preserving green spaces and trees in the city (Hamin & Gurran, 2009; Mi et al., 2019).

However, the interplay among municipal-level climate policies and measures, such as compact city building and urban forestry, presents a complex landscape of policy synergies and trade-offs. On one hand, as research continues to shed light on the pivotal role urban forests play in climate actions, cities globally are proactively developing their own urban forest strategies or management plans and updating policies to maximize the climate, ecological, and social benefits urban forests offer (Endreny, 2018; Ordóñez, 2015).

On the other hand, the pursuit of urban forests' climate benefits can conflict with other climate measures, such as the trend toward urban densification, often referred to as "compact city" approaches (Burgess, 2002, p. 9). Densification is seen as a key sustainable urban development strategy that lowers GHG emissions, reduces personal vehicle usage (Brittlebank & Clos, 2014; Brown et al., 2008), increases energy efficiency (e.g., via a district energy system) (OECD, 2012), and creates more walkable and vibrant urban spaces (Brittlebank & Clos, 2014; Williams et al., 2010). However, this approach poses significant challenges for urban forests. The competition for space with other urban infrastructure, poor soil quality, increased pollution, extreme weather, and ongoing construction and development can limit the growth and health of urban trees (Duinker et al., 2015; Jim et al., 2018). This results in reduced tree sizes (Quigley, 2004), higher mortality rates (Koeser et al., 2013; Nowak et al., 1990), and increased vulnerability to pests and diseases (Foran et al., 2015), especially in rapidly developing and densifying cities like Hong Kong (Jim, 2005), Merseyside (Pauleit et al., 2005), and Como (Brunner & Cozens, 2013), where urban forests are declining.

Understanding these dynamics is crucial because policies seldom operate in isolation. Policies interact with each other, either in supportive or constraining manners, which may lead to unforeseen or undesired results during and after implementation. The direct or indirect interplay of policies can support or undermine the implementation process and outcomes of these policies (Smith, 1973; Urwin & Jordan, 2008). Previous climate policy studies have revealed a number of trade-offs between broadly mitigative-focused and adaptive-focused climate policies (Baynham & Stevens, 2014; Newell et al., 2018). However, there is still a dearth of systematic research mapping the complex relationships (especially the potential trade-offs) among various climate policies at the municipal level (Fig. 1). The gap in research becomes even more critical as cities around the world are increasingly developing and launching urban forest policies into broader climate strategies. As these policies are put into practice, it is essential to comprehensively understand the potential trade-offs and synergies that may emerge throughout the policy planning and implementation process, contributing to more effective and successful policy integration and implementation (Cheng et al., 2021; Newell et al., 2018).

Section snippets

Study area

The study focused on municipalities within the Metro Vancouver region of British Columbia (BC), Canada. Metro Vancouver represents a high diversity of demographics, cultures, and urban forms. It is also one of the densest regions in Canada. Metro Vancouver currently accommodates 55% (2.5 million) of the population in BC. The population is expected to grow by one million people by 2050, which will require roughly 500,000 additional housing units and 500,000 additional jobs (Metro Vancouver, 2021 …

Results

The study findings reported here are organized into three sub-sections: synergies and contributing factors, trade-offs and contributing factors, and solutions for addressing trade-offs. All synergies and trade-offs were specifically about the relationships of climate policies, urban planning policies, and urban forest policies, as well as implementation processes and outcomes of these policies. …

Synergies and trade-offs: An overview

Previous studies have highlighted the importance of adequate policy support and operational capacity to the success of urban forest policy implementations (Ordóñez et al., 2019). This study, however, highlighted another area that appears to be under-studied in previous research: the need to properly plan and coordinate with policies and processes beyond urban forestry.

Through expert interviews, this study uncovered a range of trade-offs and synergies among climate, related urban planning, and …

Conclusion

The study sheds light on the intricate relationships among policies related to climate action, urban planning, and urban forest through semi-structured expert interviews. While these policies all shared a common goal of building a low-carbon and resilient urban region, the study shows the conflicting nature of their implementation, resulting in declining urban forests and loss of critical ecosystem services and community resilience to climate change. Significant trade-offs and synergies were …

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CRediT authorship contribution statement

Zhaohua Cheng: Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Lorien Nesbitt:** Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Validation, Writing – review & editing. **Cynthia Girling:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing. **Stephen Sheppard:** Resources, Supervision, Writing – review & editing. **Cecil Konijnendijk:** …

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships with other people or organizations that could inappropriately influence the work reported in this paper. …

Acknowledgements

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References (79)

M. Aminipouri *et al.*

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C. Boulton *et al.*

Factors shaping urban greenspace provision: A systematic review of the literature

Landscape and Urban Planning (2018)

S. Burch

In pursuit of resilient, low carbon communities: An examination of barriers to action in three Canadian cities

Energy Policy (2010)

Y. Chen *et al.*

Influence of urban land development and subsequent soil rehabilitation on soil aggregates, carbon, and hydraulic conductivity

Science of the Total Environment (2014)

Z. Cheng *et al.*

Alignment of municipal climate change and urban forestry policies: A Canadian perspective

Environmental Science & Policy (2021)

T.M. Conway *et al.*

Variations in municipal urban forestry policies: A case study of Toronto, Canada

Urban Forestry & Urban Greening (2007)

H.J. Davies *et al.*

Challenges for tree officers to enhance the provision of regulating ecosystem services from urban forests

Environmental Research (2017)

A.L.C. Ferrer *et al.*

Sustainable urban infrastructure: A review

Resources, Conservation and Recycling (2018)

T. Guo *et al.*

City-wide canopy cover decline due to residential property redevelopment in Christchurch, New Zealand

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…Urban forests are ecosystems characterized by a dominant presence of trees in and around cities (Salbitano et al., 2016). These forests provide numerous ecosystem services, including mitigating the impacts of climate change (Hong et al., 2024; Hutt-Taylor et al., 2022), reducing air pollution (Cornelia and Erik, 2021; Longato et al., 2023), natural hazards mitigation (Gunnell et al., 2019; Soto-Montes-de-Oca et al., 2023), supplying water (Y. Chen et al., 2023) and offering recreational opportunities (Venter et al., 2021; Weng et al., 2023), alongside cultural (Baumeister et al., 2020; Ormsby, 2021) and social values (Cheng et al., 2024; K. Su et al., 2022) for urban residents. The importance of these forests has led to the recognition that citizens' access to their services is one of the criteria for social justice and sustainable development in urban areas (Hoshyari et al., 2020).…

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