URBAN RESILIENCE THROUGH ECOSYSTEM SERVICES: AN ASSESSMENT OF GAPS AND RECOMMENDATIONS

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A Major Research Paper
presented to University of Alberta

in partial fulfillment of the requirements for the degree of

Master of Science
in
Urban & Regional Planning

Edmonton, Alberta, Canada, 2023

Executive Summary

Climate change is predicted to cause severe economic, social, and environmental impacts to cities across the globe. As such, it is paramount for cities to implement cost-effective and functional adaptation policies that reduce these negative impacts. One such approach is the incorporation of ecosystems services into the built environment as a form of green infrastructure. This approach leverages the provisioning, regulating, supporting, and cultural services of ecosystems to build urban resilience that persists with ongoing climate uncertainty. Examples of these services include the reduction of soil erosion from complex root systems, the mitigation of flood impacts through internalizing overland runoff, and the reduction of ambient air temperature by reflecting solar radiation.

To better understand how a municipality can incorporate ecosystem services into a planning approach for urban resilience, the growth and development policies of Edmonton, Canada are examined as a content analysis. This analysis is guided by two objectives: (1) to assess the extent to which Edmonton's policy approach to build urban resilience includes ecosystem services; and (2) to identify gaps in this approach and provide recommendations for improvement. In total, 18 of the 28 planning documents analysed mentioned the resiliency benefits of natural systems. Every sentence relating to implementing or advocating for ecosystem services was identified and coded into themes. Patterns in the content were identified and compared to reviewed literature on urban resilience and ecosystem services. Findings highlight that for Edmonton, ecosystem services associate with the key themes of climate resilience, public health benefits, biodiversity preservation and economic savings. Edmonton's approach to ecosystem services strongly aligns with the benefits outlined in literature, particularly the necessity for supporting biodiversity. This finding is exemplified by the persistent recognition that urban resilience is contingent on a complex foundation of biodiversity, acting as a core pillar to advocate for integrating natural systems into the urban landscape. Other benefits to integrating ecosystem services into the urban form are also highlighted, including a variety of provisioning, regulating, supporting, and cultural services. These findings align with the benefits outlined in academic literature and reflect that Edmonton thoughtfully incorporates ecosystem services into their approach to build urban resilience.

This research also identifies key gaps in Edmonton's resilience-building endeavor which include the frequent separation of human and non-human systems, a limited consideration for social accessibility, and an underdeveloped approach to ecosystem service evaluation. Recommendations are provided to improve upon these gaps, so that the expected benefits of ecosystem services are more likely to be actualized. These recommendations include:

1. Edmonton adopting a *nature-based-solution* framework for urban resilience. This approach would contribute to the overall resiliency of the urban environment, by enabling ecosystem service provision that is cautious of changing environmental contexts and the position of humans within their landscape.

2. Edmonton determining and mitigating the social impacts of naturalization and reclamation efforts by:

    a. Expanding Edmonton's education and awareness objectives for naturalization, to explicitly include consideration for how to reconcile any negative public impacts that may arise; and
    b. Edmonton reducing the generalization of '*the public'* in policy and consider how the contexts of different social groups will be impacted by the restoration of natural areas.

3. Edmonton better accounting for the positive externalities of ecosystem services in cost-benefit analyses. This would include integrating a consideration for the impacts of ecosystem services beyond that of a substitute for engineered infrastructure, like health and aesthetic value.

The Edmonton case study acts as a valuable resource for decision-makers in cities seeking to bolster their urban resilience, providing insight on both barriers and effective approaches to ecosystem service provisioning.