Extended Abstract for In the Ontario Greenbelt's Green-keeping: Evaluation of its Impact on Surface Water Pollution and Environmental Conservation *

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Abstract

This study evaluates the environmental efficacy of the Ontario Greenbelt, one of the world's largest land-use planning initiatives, by investigating its impact on surface water pollution in Southern Ontario, Canada. Established in 2005, the Ontario Greenbelt covers 2 million acres, aiming to protect agricultural lands, forests, wetlands, and water resources from urban sprawl while promoting ecological and socio-economic benefits. Despite its significance, there is limited empirical evidence assessing its direct environmental outcomes, particularly on water quality. This study addresses this gap by examining the Greenbelt's influence on key pollutants, with a focus on Biological Oxygen Demand (BOD), Chromium, Lead, and Cadmium. Previous research has primarily focused on the Greenbelt's effects on housing markets, agricultural practices, and land-use patterns (e.g., Vyn, 2012; Akimowicz et al., 2016).

1 Introduction

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2 Data

The analysis utilizes a novel and high-resolution dataset that combines information from the Provincial (Stream) Water Quality Monitoring Network (PWQMN), the Ontario Integrated Hydrology Data, and census boundary files. This dataset integrates multiple dimensions of environmental and socio-economic information, including detailed water quality indicators, river flow characteristics, spatial extents of Greenbelt coverage, and demographic factors. Socio-economic data were sourced from Statistics Canada's Census of Population and include variables such as population density, land-use patterns, and income levels at the census subdivision level. Covering 20 years (2000–2020), it captures pre- and post-Greenbelt implementation periods, enabling a robust longitudinal analysis. With hundreds of monitoring stations and a range of pollutants, this dataset provides a uniquely granular view of localized environmental impacts. Importantly, its comprehensive scope allows for precise estimation of the Greenbelt's effects, distinguishing it from other datasets in the field. BOD, a measure of organic pollution, is emphasized as the primary dependent variable due to its ecological relevance. Additional data on socio-economic characteristics are incorporated to control for confounding factors.

3 Methods

A quasi-experimental design leveraging spatial discontinuities at the Greenbelt boundaries is employed. Specifically, pollution levels upstream and downstream of protected areas are compared using a (triple) difference-in-differences approach. This strategy isolates the causal impact of the Greenbelt by accounting for unobservable factors that are constant over time and space. The model includes fixed effects for census subdivisions, monitoring stations, and temporal trends. An event study is also conducted to validate the parallel trends assumption and capture dynamic treatment effects over time. This methodology builds on existing environmental economics frameworks, such as those by Lipscomb and Mobarak (2017), while tailoring the analysis to the Greenbelt's unique policy context. Robustness checks include placebo tests with heavy metal pollutants and sensitivity analyses for alternative model specifications.

4 Results

The findings indicate that the Greenbelt significantly reduces BOD levels in river segments with higher shares of protected land. The average reduction in BOD is approximately 12.4% to 14.7% for every percentage point increase in the share of river segments falling within the Greenbelt boundaries, depending on the specification. This reduction is statistically significant at the 1% level and consistent across multiple model formulations.

Placebo tests conducted on Chromium, Lead, and Cadmium reveal no significant effects, confirming the specificity of the Greenbelt's impact on organic pollution. These heavy metals are less influenced by land-use policies, as their primary sources are industrial discharges and atmospheric deposition, which are not directly addressed by the Greenbelt's restrictions. The results of the event study further substantiate these findings, showing that reductions in BOD emerge shortly after the Greenbelt's establishment and remain stable over time. The absence of pre-trend differences between upstream and downstream locations supports the validity of the identification strategy.

5 Discussion

The results highlight the Ontario Greenbelt's effectiveness in mitigating surface water pollution, particularly organic contaminants. The significant reductions in BOD can be attributed to mechanisms such as improved natural filtration through wetlands, reduced agricultural runoff due to land-use restrictions, and the preservation of riparian buffers. These findings align with the Greenbelt's stated objectives of safeguarding water resources and maintaining ecological integrity.

The lack of significant effects on heavy metals underscores the targeted nature of the policy's impact. While the Greenbelt effectively addresses diffuse sources of pollution, such as agricultural and urban runoff, it does not directly mitigate point-source pollutants like heavy metals. This distinction provides valuable insights for policymakers seeking to optimize land-use policies to achieve broader environmental goals.

6 Conclusions

The Ontario Greenbelt demonstrates the potential of urban containment policies to generate substantial environmental benefits. By curbing urban sprawl and preserving natural landscapes, the Greenbelt mitigates adverse impacts of human activities on water quality. The study's results are robust to multiple sensitivity tests and provide empirical support for the Greenbelt's role in promoting ecological health.

From a policy perspective, these findings emphasize the importance of integrating spatial planning with environmental conservation objectives. The success of the Ontario Greenbelt offers a model for other jurisdictions considering similar strategies to balance development and environmental sustainability. Future research could explore the Greenbelt's broader ecological impacts, including biodiversity conservation and climate resilience, to provide a more comprehensive understanding of its contributions to sustainable development.

This study contributes to the literature on environmental economics and land-use planning by providing novel evidence of the Ontario Greenbelt's effectiveness. By utilizing high-resolution data and rigorous quasi-experimental methods, it demonstrates the value of empirical analysis in evaluating large-scale environmental policies. These findings serve as a basis for informed decision-making and highlight the potential of urban containment strategies to address pressing environmental challenges in rapidly urbanizing regions.