Research Statement

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My research lies at the intersection of environmental, urban, and regional economics. I study how environmental quality and natural amenities influence social and economic outcomes, and how policies can mitigate environmental risks while supporting sustainable development. A central feature of my work is the use of causal inference and a variety of econometric methods, combined with novel data sources such as remote sensing, machine learning, and spatial big data. This approach allows me to provide rigorous evidence on how environmental change and policy interventions shape labor markets, health, and community resilience. My research agenda is motivated by two complementary goals: advancing empirical understanding of environment - economy interactions, and generating policy relevant insights for improving welfare and resilience in vulnerable communities.

My dissertation consists of three chapters that examine the economic and social effects of environmental quality from multiple perspectives. The first chapter, published in *Environmental and Resource Economics*, investigates how air pollution affects chronic school absenteeism, a key predictor of long term educational and socioeconomic outcomes. While prior research has studied general school attendance and short term test scores, little was known about chronic absenteeism, which matters more for long run outcomes. Using a national sample of schools and six criteria pollutants monitored by the U.S. Environmental Protection Agency, I apply an instrumental variable strategy based on wind direction to address endogeneity in local pollution exposure. I find that additional days of poor air quality increase chronic absenteeism even when pollution is below EPA standards, with stronger impacts for disadvantaged students. These results highlight the hidden costs of sub-threshold pollution exposure and underscore the importance of strict air quality regulation for protecting human capital formation and equity in education.

My second paper examines urban greenspace as an environmental amenity that influence workers' wage decisions. Using Normalized Difference Vegetation Index (NDVI) and county level panel data from 2011 to 2019, I estimate a spatial equilibrium model of compensating differentials, which hypothesizes that workers trade off wages to be in a greener city. To address potential endogeneity, I instrument for current vegetation with historical land cover patterns from the 1970s and 1980s. Results indicate that workers are willing to accept lower wages to live in greener cities, while employment and population growth are higher in those areas. These findings demonstrate that greenspace is not merely an aesthetic feature but a driver of urban amenities and economic growth. By documenting the economic value of urban greenery, this paper contributes to debates on sustainable urban development and the role of environmental amenities in shaping regional competitiveness.

The third paper examines how upstream agricultural production and regulatory incentives jointly shape Safe Drinking Water Act compliance in downstream communities. I use remote-sensed agricultural output to construct an upstream flow matrix of about 100,000 HUC-12 watersheds and link it to public water system violation records from 2010 onward, following EPA's shift to a point-based enforcement system. By combining this hydrologic network with a staggered difference-in-differences design, I show that nutrient-intensive upstream agriculture increases the likelihood of downstream

drinking water violations and that public water systems often respond by substituting contaminant violations with monitoring or reporting violations to face lower penalties. The paper quantifies the external costs of agricultural production in terms of drinking water safety, highlights how current regulatory design can distort compliance behavior, and points toward the need for targeted upstream interventions and redesigned enforcement to better protect vulnerable systems. Together, these papers demonstrate how environmental quality influences outcomes in education, labor markets, and public health, three fundamental domains of human welfare.

Beyond my dissertation, I am developing a broader research agenda that deepens my focus on environment and resilience while expanding into the economics of energy. My ongoing work examines natural disaster disruption and recovery using nighttime lights and cell phone mobility data to track population displacement and return after wildfires. This approach allows me to quantify the economic resilience of disaster-hit areas and to identify factors that accelerate or hinder recovery. I plan to extend this analysis to other hazards such as floods and hurricanes, with particular attention to how public policy, infrastructure investment, and migration dynamics shape the pace and equity of recovery. In parallel, I am building an energy-systems stream centered on forecasting and community impacts: modeling sustainable energy pathways for West Virginia, to analyze implications for emissions, load, generation mix, reliability, and retail rates. I link these scenarios to regional economic outcomes, using Input-Output models, to estimate jobs, income, and fiscal effects at the county level and to assess distributional issues such as energy burden. Going forward, I will expand this work to compare transition pathways across coal-reliant regions, evaluate rate design and transmission/storage investments, and study how policy can maximize local benefits while managing equity and demand growth.

A second domain of my research focuses on urban and regional dynamics, where I integrate remote sensing and machine learning into the study of environmental amenities and local economic development. Central to this agenda is the development of UrbanEye, an open source Python toolkit that applies computer vision to street level imagery such as Google Street View to generate indicators of public space conditions. UrbanEye captures the lived environment at a fine spatial scale, offering new insight into neighborhood-level variation in environmental quality. My future plans include training multimodal models to expand the set of urban features detected, enabling systematic comparisons across cities worldwide. These innovations will not only provide richer measures of urban quality of life but also enhance empirical models of spatial equilibrium by linking amenities, housing markets, migration, and wages. In this way, UrbanEye serves both as a methodological contribution and as a foundation for a broader research program in urban and regional economics.

Overall, my research combines environmental economics, regional science, and applied microeconomics to address pressing policy questions. By integrating remote sensing, machine learning, and causal inference, I provide new evidence on how environmental quality affects labor markets, health, and resilience. In doing so, my work advances both academic understanding and practical policy design. Over the long term, I aim to build a research program that contributes to the literature in environmental and regional economics while equipping policymakers with tools to promote equitable and sustainable development.