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In the shadow of production: Coal waste accumulation and environmental inequality formation in Eastern Kentucky

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ABSTRACT

This article advances an environmental-sociological and quantitative spatial-analytic approach to the study of environmental inequality formation in coal country. We use spatial error regression models in a case study of 2000 census block group proximity to hazardous coal waste impoundments amidst shifting coal production trajectories and impoundment disaster contexts in the declining Eastern Kentucky coalfields. Proximity to abandoned and sealed mines, coal production density, and the “buffering effect” of rural-agricultural context are the most powerful predictors of impoundment proximity in the period encapsulating the boom years of coal production and culminating in 2000. Amidst continued coal industry decline and the post-2000 Martin County impoundment disaster context, proximity to older impoundments, including the failed Martin County impoundment, proximity to abandoned and sealed mines, and poverty levels by 2000 are the most powerful predictors of proximity to impoundments sited from 2001 to 2006. Findings have important environmental justice research and policy implications.

1. Introduction

Qualitative case studies extend [Pellow's \(2000\)](#) “environmental inequality formation” (EIF) framework to show how and why intergroup dynamics and various political, economic, cultural, and spatial contexts interact with environmental hazards throughout their life-cycles to shape the unequal distribution of power, resources, and environmental benefits and burdens in society (e.g., [Downey, 2015](#); [Malin, 2015](#); [Pellow, 2002](#)). Quantitative EIF case studies focus predominantly on the postindustrial (i.e., post-1970) historical context of urban residential settlements experiencing disparate proximity to industrial hazards (e.g., [Downey, 2005b](#); [Pastor et al., 2001](#); [Saha and Mohai, 2005](#)).¹ For example, [Saha and Mohai \(2005\)](#) demonstrate that nonwhite and socioeconomically disadvantaged census tracts experienced disparities in hazardous industrial waste siting in Michigan after 1970. Those disparities intensified in the post-1980 era of increasing public awareness of hazardous industrial waste following the Love Canal, New York disaster, the passage of the 1976 Resource Conservation and Recovery Act, and political mobilizations by whites and elites who were able to channel hazardous industrial land uses away from their neighborhoods.

While insightful, earlier quantitative EIF research has two important limitations. First, it focuses on disparate residential proximity to polluting manufacturing facilities or large-scale hazardous waste sites in urbanized settings (e.g., [Downey, 2005a, 2005b](#);

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¹ Disparate proximity is a specific spatial form of environmental inequality, which occurs “when members of a specific social group live closer to some set of hazards than we would expect if group members were randomly distributed across residential space” ([Downey, 2005a:355](#)).

Pastor et al., 2001; Saha and Mohai, 2005; Szasz and Meuser, 1997). These environmental indicators represent the latter stages of the pollution production process: what Pellow (2000) calls “end of the pipe” environmental hazards. This bias shifts attention away from how hazardous wastes are “associated with resource extraction that may unequally impact disadvantaged rural and resource-dependent communities” (Greenberg, 2017:150; see also Ashwood and MacTavish, 2016; Pellow, 2016). Our analysis of residential settlements near coal waste impoundments helps to address this limitation by providing a “beginning of the pipe” perspective that focuses on hazards that predominate in the rural and resource-dependent communities (Greenberg, 2017; Flint and Luloff, 2005) and that are created in conjunction with the extraction—rather than burning—of coal (c.f., Clark et al., 2012).

Coal waste is produced through an intensive process following extraction, whereby impurities are washed away from coal with chemicals and, since the middle of the 20th century, pumped into large earthen dams called impoundments (Michalek et al., 1996). Coal waste impoundments are associated with large-scale production processes, but they also exist “in the shadow of production”: they are growing in size and use independent of production tonnage. Their unprecedented growth rates are attributable to their ability to make profitable the mining of otherwise cost-prohibitive coal seams, as well as to the depletion of high-grade ores across the world (Hudson-Edwards, 2016). Lower-grade resources result in higher quantities of waste that must be extracted and managed—typically through the industry-preferred and government-permitted use of massive coal waste impoundments that fill mountain valleys and basins with billions of gallons of toxic coal waste.

Coal waste impoundment failures have caused some of the most tragic disasters in U.S. history, including the 1972 Buffalo Creek flood of sludge-like waste that killed 125 people in rural West Virginia (Erikson, 1976). Despite the U.S. government establishing stricter engineering standards for coal waste impoundments after the Buffalo Creek disaster, some experts refer to impoundments as among the riskiest and largest man-made structures on Earth (Robertson, 2011). An impoundment failure in Martin County, Kentucky in 2000—discussed in our case study below—underscored the persistent risk of impoundment disasters (McSpirit et al., 2007). Even absent catastrophic failure, leaky impoundments pose a significant contamination threat to surface and ground water, and they have been correlated with elevated health problems, such as cancer (Epstein et al., 2011:81; Hendryx et al., 2010; Palmer et al., 2010).

A second limitation in previous quantitative EIF research is that it has developed mostly in isolation from relevant theoretical frameworks within the subfield of environmental sociology that might further illuminate how various contextual factors condition the formation of environmental inequalities. Environmental sociology was established in the late 1970s at the sometimes-troubled meeting of human ecology and Marxist political economy, whose tensions reflected broader and ongoing debates in sociology and other social sciences (York and Mancus, 2009; see also Lobao et al., 2007). Marxist political economy in environmental sociology overlaps with “structural” human ecology in their concern over the environmental impact of economic development. However, structural human ecology highlights how human populations place pressures on the environment and how humans adapt to the environment, while Marxist political economy illuminates the historical, political, and economic dynamics that contribute to social and environmental inequalities.

Our study contributes to a growing literature (e.g., Burns and Rudel, 2015; Clark et al., 2012; McKinney et al., 2015; York and Mancus, 2009), which uses Marxist political economy to critique and integrate with structural human ecology and related concepts of ecological resilience to understand coupled human and natural systems. We synthesize environmental-sociological theories primarily concerning the historical and political-economic dynamics—and secondarily population contexts—that contribute to the unequal distribution of hazardous coal waste in our study area. In the process, we also contribute more broadly to the sociology of spatial inequality (Lobao et al., 2007) by examining “who gets what where” in the context of environmental burdens in rural and resource-dependent communities.

We begin below with a review of our theoretical considerations, Eastern Kentucky case study, and guiding hypotheses. We then use spatial error regression models in an analysis of 2000 census block group proximity to hazardous coal waste impoundments during shifting coal production trajectories and impoundment disaster contexts in the declining Eastern Kentucky coalfields. We find that proximity to abandoned and sealed mines, coal production density, and the “buffering effect” of rural-agricultural context are the most powerful predictors of proximity to impoundments sited in the period encapsulating the boom years of coal production from 1976 to 2000. During coal industry decline and in the post-2000 Martin County impoundment disaster context, we find that proximity to older impoundments, including the failed Martin County impoundment, proximity to abandoned and sealed mines, and poverty levels by 2000 are the most powerful predictors of proximity to impoundments sited from 2001 to 2006. We close by discussing the scholarly and practical implications of this study for future environmental justice research and policy pertaining to coal waste impoundments.

2. Theorizing rural environmental inequality formation in coal country

Rural America is typically understood as a site of concentrated poverty, a historical repository of natural resources, and a dumping ground for locally unwanted land uses (Lichter and Brown, 2011; Pellow, 2016). Recently, research has illuminated how rural environmental inequality also involves the lack of rural residents’ participation in local land-use decisions (Malin and DeMaster, 2016), the “othering” of rural residents in legal proceedings (Van Wagner, 2016), and environmental health disparities in rural areas (Kelly-Reif and Wing, 2016). Freudenburg (2006) argued that many of these forms of rural environmental inequality are manifestations of a “social multiplier effect.” In this dynamic, residents of rural and resource-dependent communities support potentially harmful industries, which are frequently susceptible to boom and bust cycles, because they have friends or relatives who benefit from employment in the industries and/or because their community identities are tied to the industry (see also Bullard, 1990; Malin, 2015; Scott, 2010). We review key theoretical frameworks in the environmental sociological literature that help to unpack the social multiplier effect and further specify the demographic and political-economic dynamics that contribute to disparate proximity to coal waste impoundments in our Eastern Kentucky case.

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