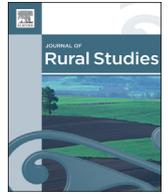




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# A devil's bargain: Rural environmental injustices and hydraulic fracturing on Pennsylvania's farms<sup>☆</sup>

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## ABSTRACT

Rural Pennsylvania, the epicenter of the Marcellus Shale region, hosts the most prolific unconventional natural gas extraction and production activity in the US. Farmers of small and mid-sized operations in Marcellus counties depend increasingly on incomes from booming natural gas operations, while the industry needs their land to access energy resources. These farmers thus bridge two economic sectors—unconventional natural gas production and agriculture. Related dynamics rapidly transform the social, economic, and environmental landscapes for Pennsylvania's rural communities. We ask: What, if any, are the environmental justice implications of the unconventional natural gas industry's presence in rural agricultural spaces, particularly for farmers with small and mid-sized operations? Presenting findings from 42 in-depth interviews, participant observation, and archival analysis, we show how farmers benefit from natural gas leases to support their agricultural livelihoods. However, they face a devil's bargain. Farmers risk entrenchment in a long-term web of natural resource dependence, increasingly unable to determine their livelihoods or land use on their own terms. Our study demonstrates how farmers' intersectoral dependence conditions procedural inequities and greater environmental risk. We show how farmers of small and mid-sized operations experience rural environmental injustices as they endure corporate bullying; face procedural inequities negotiating and enforcing lease terms; and increasingly contend with environmental risks associated with unconventional natural gas production.

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## 1. Introduction

In the last decade, hydraulic fracturing – an unconventional oil and natural gas extraction method – has been utilized at an unprecedented scale throughout the US (EIA, 2012), rapidly transforming the social, economic, and environmental landscapes for dozens of rural communities. Commonly known as “fracking,” hydraulic fracturing extracts previously inaccessible deposits of petroleum and natural gas trapped in shale formations. By

utilizing this technology and constructing a web of industrial infrastructure that includes tank batteries, pipelines, and compressor stations, the US has become the largest producer of natural gas and oil in the world (EIA, 2015a). The 104,000 square-mile Marcellus Shale gas formation beneath Pennsylvania, New York, Ohio, and West Virginia hosts the most prolific natural gas extraction activities in the US, producing over 16,000 cubic feet of natural gas per day<sup>2</sup> (EIA, 2015b). Marcellus communities experience extensive impacts from surging hydraulic fracturing and associated industrial development, sometimes near homes, hospitals, and schools.<sup>3</sup>

In Pennsylvania, the Marcellus region's production epicenter, many residents of impoverished rural counties like Bradford and

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<sup>2</sup> Compared to an average of 6900 cubic feet/day produced by the second-place Eagle Ford Shale region.

<sup>3</sup> Uneven state-by-state regulation allows for variable conditions in different states (Author, 2013; Boxerman et al., 2013).

Susquehanna welcome the economic boom associated with unconventional natural gas production. Yet these residents simultaneously contend with environmental risks and uncertainties and increasingly find themselves less able to independently determine their livelihoods and land use. Farmers in these rural regions often bridge two natural resource dependent economic sectors – unconventional natural gas and agricultural production – as both sectors utilize the same farmland for radically different land uses.

Some farmers with natural gas production on their land, particularly those who own their mineral rights, have been portrayed in popular media as “shale-ionaires”.<sup>4</sup> They may sign lucrative leases allowing natural gas companies land and subsurface access. Without this access, the industry encounters barriers to the construction and installation of wellpads, storage facilities, and pipelines that transport natural gas to processing and trade hubs. Farmers who sign leases typically benefit financially from signing bonuses and/or royalties when natural gas is produced, particularly if their ownership rights extend beyond the surface to subsurface (mineral) rights. The initial financial benefits may be substantial, especially for mineral rights holders.<sup>5</sup>

However, the considerable focus on the financial benefits Pennsylvania farmers may experience can elide other critical social and environmental concerns, obscuring ways that the natural gas boom may place certain Pennsylvania farmers at risk. Within our case study analysis, we interviewed 36 farmers who manage small and/or mid-sized operations, 31 of whom owned their mineral rights.<sup>6</sup> Our findings demonstrate that owning land and/or having mineral rights does not necessarily afford farmers of small and mid-sized operations decision-making power over how their land is used for natural gas production. Our findings also demonstrated that owning land and/or mineral rights fails to facilitate meaningful participation in the processes of negotiating and enforcing related lease terms. Moreover, these economically marginalized farmers can face increased exposure to various environmental risks upon entering into private agreements with the unconventional natural gas industry (Jacquet, 2014).

In Pennsylvania, small and mid-sized farm operations already contend with persistent economic marginalization (Bienkowski, 2015), unstable global markets, and increasing costs for agricultural land and other inputs. In counties like Bradford, Susquehanna, and Washington,<sup>7</sup> for example, competition from large, consolidated, and vertically integrated agribusiness firms (particularly in sectors like dairy) renders small and mid-sized farm operations especially susceptible to market downturns (Adams and Kelsey, 2012). While natural gas production may mean an initial infusion of cash, we found that farmers experience environmental injustice and risk by becoming entrenched in a long-term web of

dependence between these two natural resource dependent industries. This intersectoral dependence may limit farmers' long-term decision-making agency, as well as their capacity to mitigate environmental risks.

The farmers in our study who owned small and mid-sized operations felt constrained to accommodate particular industry practices that often included increased exposure to myriad environmental risks and uncertainties. For operators of these farms, environmental risks – now increasingly documented across the US (see also: St. Fleur, 2015; Kelly, 2014) – include: public health impacts, such as increased rates of birth defects within a half mile of wellpads (McKenzie et al., 2014); water contamination, including loss of household water quality; harm to livestock (Mint Press News, 2015; Wilber, 2012); increased traffic, noise and light pollution (Brasier, 2014); decreased property values (Brasier et al., 2011; Cooley et al., 2012); inequitable and restricted access to information about chemicals used in unconventional production (Colborn, 2011); disturbed landscapes; and diminished quality of life (Perry, 2013; McKenzie et al., 2014).

Recent studies characterize the impacts from the disproportionate number of wells in Pennsylvania's poor communities – particularly on rural farmland in counties such as Bradford and Susquehanna – as examples of rural environmental injustice (Bienkowski, 2015; Ogneva-Himmelberger and Huang, 2015). Farmers we interviewed with small and mid-sized operations also reported experiencing corporate bullying and related disempowerment throughout the leasing and production processes and described the need to fight to receive promised royalty payments. These patterns align with journalistic investigations in which landowners reported similar experiences of procedural inequity (Kelly, 2014; Lustgarten, 2013).

To date, limited sociological research examines the relationships between rural environmental injustice and intersectoral natural resource dependence. Yet Pennsylvania Extension notes the need for more research, observing: “There is some association between Marcellus shale activity and dairy farming...and other types of farming...that requires further study and consideration,” beyond anecdotal assessments suggesting that all farmers have benefited from natural gas development during the current boom (Adams and Kelsey, 2012: 4). To address this research gap, we ask: What, if any, are the environmental justice implications of the unconventional natural gas industry's presence in rural agricultural spaces, particularly for farmers with small and mid-sized operations?

To examine this question, we draw upon a study we conducted with Pennsylvania farmers in 2012, utilizing findings from 42 in-depth interviews,<sup>8</sup> participant observation, and archival analyses. We show how Pennsylvania farmers of small and mid-sized operations rely economically on the hydraulic fracturing boom. They leverage unconventional natural gas leases to supplement modest farm incomes and limited federal subsidies; alleviate debt and maintain their farm for their future generations; and/or to transition to less intensive forms of farming. Early in our study, we also interviewed owners of six larger farming operations, through the initial network sampling suggestions offered by key Pennsylvania State extension agents. These larger operators played important roles as gatekeepers by providing initial contacts with small and mid-sized farmers that were vital for this project. Yet it quickly became clear that their environmental justice experiences varied and that scholarly investigations of the experiences of small and

<sup>4</sup> For example, see 60 Minutes' segment on them at: <http://www.cbsnews.com/videos/extra-meet-the-shaleionaires/>.

<sup>5</sup> Mineral rights refer to owning some portion (or all) of the mineral wealth underground, typically below 300 feet. This division of surface and underground wealth is an historical arrangement, brokered between the federal government, states, and large industries like the rail sector. Unlike states like Colorado, where split estate dominates and means that surface and mineral rights are often severed, mineral rights ownership is much more common among Pennsylvania landholders like farmers. See <http://www.leg.mt.gov/content/publications/environmental/hb790brochure.pdf>.

<sup>6</sup> We utilize estimates of farm size were informed in part by USDA characterizations of small and midsize farms in the region. These are defined for our study as farmers with less than 500 acres and/or 200 livestock. Large farmers have over 500 acres and/or more than 200 livestock.

<sup>7</sup> These three counties encompass our study site, as described in the Methods section.

<sup>8</sup> As described in Methods, 36 of these interviews were with small and mid-sized farmers, and six were conducted with Pennsylvania State Extension agents.

midsized operations with unconventional natural gas production on their land merited greater attention. Nevertheless, in future research we suggest that a robust comparison of the experiences of farms of various sizes would prove fruitful; our limited sample of large farms indicated that approximately one-third of operators of larger farms had largely positive experiences with natural gas production on their farmland.

Significantly, operators of small and midsized farms that we interviewed describe how they feel constrained to allow unconventional natural gas production on their farmland. We find that as these farmers experience intersectoral dependence between both the unconventional natural gas sector and the agriculture sector, this compounds their social and economic vulnerabilities. We therefore find that decisions to sign natural gas leases are not simply free, beneficial, rational<sup>9</sup> economic choices for farmers who wish to participate in energy production. Instead, they represent a lack of procedural equity, which subsequently exposes those operating small and midsized farms to increased environmental risks. We contend that these procedural inequities<sup>10</sup> represent an important but overlooked form of rural environmental injustice, where rational action is shaped via consolidated markets and corporate bullying.

## 2. Environmental injustice and intersecting natural resource dependencies

We ground this analysis in three sociological literature: environmental justice, natural resource dependence, and the sociology of agriculture. We combine insights from these literature to examine ways that farmers of small and midsized operations in Pennsylvania experience intersecting vulnerabilities that condition this unique case of rural environmental injustice.

### 2.1. Environmental justice

We define environmental justice (EJ) as the ability of people, regardless of “race, color, national origin, or income” (EPA, 2012) to experience freedom from environmental risks where they live, work, and play (Taylor, 2000). Importantly, our definition encompasses a central but sometimes under-articulated aspect of EJ – namely, meaningful and democratic participation in decisions related to locally undesirable land uses (LULUs) (Freudenburg and Pastor, 1992) near people’s homes or communities (Lake, 1996), such as landfills, waste incinerators, and mining, drilling, or other extractive operations (Arnold, 2000; Shrader-Frechette, 2002; Ishiyama, 2003; Salkin, 2006).

Concern over the exposure of vulnerable populations to LULUs motivated historical EJ activism in the US. Social mobilization in Love Canal, New York, and Warren County, North Carolina, precipitated a flood of pioneering research on inequitable exposure of marginalized populations to environmental risks (Mohai et al., 2009). Researchers found that communities with higher percentages of racial and ethnic minorities and higher poverty rates were more likely to have LULUs, such as hazardous waste sites (US GAO,

1983; Bullard, 1983; UCC Commission on Racial Justice 1987). Inspired by these findings, by the passage of Clinton’s Executive Order 12898 in 1992, and by successes of the US Civil Rights movement (Taylor, 2000), US EJ activists mobilized to address unjust policies (Sze and London, 2008), gain equal legal protection from environmental hazards (LaVelle and Coyle, 1992), and create mechanisms facilitating procedural equity related to land use decisions (Lake, 1996).

While subsequent EJ research continued to debate and examine racial and other demographic characteristics of waste sites and pollution created by industrial facilities (Bryant and Mohai, 1992; Bullard, 1993, 1994; Hofrichter, 1993), the field began to include more historical-comparative and community-based research (Pulido, 1996; Szasz and Meuser, 1997; Pellow, 2001). Case studies increasingly interrogated institutional and structural components of environmental racism and other injustices (Hurley, 1995; Taylor, 2000; Pellow, 2002; Brown, 2007; Mohai et al., 2009), as well as environmental health impacts (Brown, 2007; Corburn, 2005; Brown and Mikkelsen, 1990; Novotny, 1998), primarily in urban settings.

Roberts and Toffolon-Weiss (2001) turned to rural outcomes in Louisiana when they identified the profit motive and alliances between businesses and the state as primary mechanisms behind unjust land use decisions impacting Louisiana communities. Subsequent studies interrogated EJ in rural development contexts, including: toxic and chemical pollution in the South’s Cancer Alley area (Allen, 2003; Lerner, 2005); sacrifice zones across former U.S. manufacturing hubs (Lerner, 2005); military and hazardous wastes left in rural and Native American communities (Malin et al., 2010; Malin and Petrzalka, 2011; Malin, 2015; Hooks and Smith, 2004, 2005; Ishiyama, 2003; Kuletz, 2001, 1998); and environmental health outcomes of pesticide exposure (Pulido, 1996; Brown, 2007; Holmes, 2013). Still, little work has examined how environmental injustice in these rural spaces may be linked to other natural resource-dependent industries.

Important research has begun in international contexts. For example, the World Conservation Union published a report entitled “Environmental Justice and Rural Communities” focused on EJ in resource-dependence areas of India and Nepal (Moore and Pastakia, 2007). Similarly, the international food sovereignty movement, with its emphasis on injustices faced by peasant smallholders and small-scale agriculturalists, has roots in the global south (e.g. Glipo and Pascual, Jr. 2007, Altieri and Toledo, 2011, Edelman, 2013). Yet conditions fostering rural environmental injustices in the daily lives of small and midsized farmers are not fully examined in the US context.

In Pennsylvania, extractive industries and agriculture have co-existed for decades. However, scholars have focused primarily on EJ activism in Pennsylvania’s more urban spaces, such as Chester (Foster, 1999) or the controversial Harrisburg incinerator case,<sup>11</sup> rather than on patterns of vulnerability in the state’s rural spaces. As such, there is much to be learned about the historical, structural dynamics that shape unjust land use decisions within rural areas, particularly through community-level economic dependence on natural resource-based industries like agriculture or mining (Malin, 2015), in Pennsylvania and more broadly.

Examining the aspects of rurality – such as economic marginalization – that condition natural resource dependence in Pennsylvania can help us better understand cases of rural environmental injustice related to natural gas production. For example, Ogneva-Himmelberger and Huang (2015) found that impoverished

<sup>9</sup> We employ “rational” here in an economic sense, following rational choice theory and the notion that individuals will based economic decisions on their own “highest self-interest,” to achieve the maximum benefit possible. In particular, we also suggest that “rational” implies that farmers will be able to make decisions with “perfect information,” one of the foundational assumptions of economic rationality. See also Granovetter, 1985.

<sup>10</sup> We expand on the environmental justice concept procedural equity (e.g. Lake, 1996) by drawing from Leventhal (1980). We define “procedural injustice” or inequity as inattention to a fair process characterized by “consistency, accuracy, ethicality, and lack of bias,” and in which actors feel they “have a voice.”

<sup>11</sup> For example, see: <http://www.umich.edu/~snre492/Jones/harrisburg.html>.

populations in rural Pennsylvania experienced the most vulnerability to LULUs related to unconventional shale wells. Author (2013) and Hudgins and Poole (2014) interrogate the influences of neoliberalism on land use decisions and environmental governance mechanisms in the state, respectively. Perry (2012) observes that EJ and other quality of life outcomes related to hydraulic fracturing result in “collective trauma” in Bradford County, Pennsylvania.

Generally, however, sociologists have yet to systematically analyze EJ outcomes of unconventional oil and gas production across the U.S. and globally (Willow and Wylie, 2014). And environmental injustices related to class, economic vulnerability, and spatial location in this context remain underexplored. Moreover, the specific impacts to farmers of small and midsized operations who navigate between two industries, unconventional natural gas production and agriculture, merit more analysis.

## 2.2. Natural resource dependencies and community vulnerability

Unconventional natural gas development increasingly depends on privately-held farmland (Jacquet, 2014), creating distinct forms of natural resource dependence and multiplying links between extractive industries and agriculture. In locations like Pennsylvania, where landowners have not mobilized coalitions like in New York (Stedman and Jacquet, 2011), these links can compound small and midsized farmers' vulnerabilities.

Rural communities whose economies depend significantly on natural resources face social, economic, and environmental instability and uncertainty. Boom and bust cycles (e.g., Brown et al., 2003; England and Albrecht, 1984) and seasonal, weather-related fluctuations mean that natural resource dependent communities (NRDCs) are frequently vulnerable to economic instability, to dramatic trends in global commodities markets, and to localized un- or underemployment, whether they supply raw materials for energy production or food consumption (Krannich and Luloff, 1991; Humphrey et al., 1993). Freudenburg (1992) asserted that NRDCs are subject to economic shocks generated extra-locally, through what he termed the “cost-price squeeze.” While global prices for commodities tend to fall, costs of local production continue to rise. Freudenburg and Gramling (1998) used Louisiana's petroleum extraction industry to show that even without regional petroleum resources being depleted, extraction slowed for multiple other reasons related to global market prices. Forward and backward linkages might create stable economic development in NRDCs, but establishing these linkages is rare for NRDCs because resource extraction has seldom led to stable connections to the wider economy (Bunker, 2005). Yet these dependencies persist, perhaps due to over-adaptations to given industries, which can sometimes mimic economic addictions (Freudenburg, 1992; Freudenburg and Frickel, 1994).

Due in part to their natural resource dependence, U.S. rural communities face a diverse constellation of interrelated problems: rates of rural poverty (17.7%) in the U.S. outpace those of many metropolitan areas (DeNavas-Walt et al., 2014); widespread unemployment plagues many rural communities; and food insecurity affects approximately 3.1 million rural households (Coleman-Jensen et al., 2013). Environmental pressures such as climate change, pollution, land degradation, and the swift diminishing of high-quality freshwater resources all place increasing pressure on the natural resources of rural working landscapes, narrowing choices for rural residents and increasing environmental risk.

Persistent economic vulnerabilities have been consistent structural disadvantages in rural NRDCs. Humphrey et al. (1993) identified rural deindustrialization, extra-local power of extraction industries over communities, and core-periphery relations between urban and rural areas in the U.S. as key mechanisms in

rural impoverishment. Further, Peluso et al. (1994) found that rural NRDCs act as internal colonies or peripheries to core areas with more political-economic power, rendering NRDCs vulnerable to persistent poverty and to economic devastation if extralocal markets or industries on which they depend falter.

Schafft et al. (2013, 2014) and Brasier (2011, 2014) have examined relationships between community well being and the Pennsylvania natural gas boom, drawing upon the insights of community leaders to emphasize impacts to community infrastructure and services like schools. Our work builds upon this important scholarship to explore ways that small and midsized farmers in Bradford, Susquehanna, and Washington Counties – whose daily lives pivot on intersecting natural resource dependencies – experience unique forms of environmental risk and procedural injustice.

These counties have historically hosted natural resource-dependent industries such as forestry, agriculture, and tourism. They have also been central to the natural gas boom in Pennsylvania. For example, Bradford and Susquehanna counties alone produced 41% of the total Marcellus natural gas extracted in June 2014 (Kelly, 2014). But dependence on these sectors has also helped structure the region's persistent economic marginalization, making it one of the most chronically poor pockets of Pennsylvania (US Census Bureau, 2012; Brasier et al., 2011). While Washington County has a more diversified economy (US Census Bureau 2010), it still relies on coal extraction, has a growing small-scale agricultural economy, and increasing wet natural gas production (EIA, 2015a,b).

## 2.3. Pennsylvania farming: farmers' structural vulnerabilities

Nationally, a host of trends in agriculture challenge the viability of small and midsized farms. The vertical integration and consolidation of supply chains (Heffernan et al., 1999; Hendrickson et al., 2002; Hauter, 2014; Howard, forthcoming); the increasing concentration of key agricultural inputs such as the seed and chemical sectors (Howard, 2009); highly competitive global commodity markets; high fuel costs; and new food safety and water contamination regulations collectively combine to advantage larger, consolidated operations, while marginalizing US small and midsized farms.

While rural agricultural sociological scholarship explores the challenges faced by rural farmers (e.g. see Lyson et al., 2008), the US food justice literature tends to focus primarily on entrenched structural injustices in urban spaces. As Agyeman and McEntee (2014: 212) note, “Food justice as a social movement arose largely from urban-located social justice groups that explicitly addressed food inequalities based on race and/or socioeconomics.” And while alternative food social movements have championed rural farmer voices, fostering an idealized rural nostalgia, these same voices are frequently appropriated or underrepresented within alternative food systems discourse and analysis (Bowen and De Master, 2014). Notable exceptions explore injustices experienced by agricultural workers and indigenous groups (e.g. Brown and Getz, 2008, 2011; Harrison, 2006, 2011; Alkon and Agyeman, 2011; Holmes, 2013) and the racial aspects of agricultural ownership (e.g. Gilbert, 2003; Gilbert et al., 2002; Wood and Gilbert, 2000). While these examinations are critical, marginalized rural agricultural voices also merit scholarly attention, particularly within NRDCs.

In rural Pennsylvania counties, agriculture has been a strong component of the local economy for centuries. Nevertheless in our study, farmers that operated small and midsized farms faced numerous contemporary threats to their viability. These threats include structural dynamics described above and changing demographics, such as farmer retirements, rural outmigration, Pennsylvania's decline in number of dairy cows, particularly in

Bradford County (Center for Rural Pennsylvania, 2014), and a national trend of 400 millions acres of farmland transitioning out of current forms of production in the next 20 years (Ross, 2013).<sup>12</sup>

Adding to these demographic shifts, Pennsylvania farmers of small and midsized operations face significant vulnerabilities due to sector-specific consolidation. In the dairy sector – a primary commodity sector for Pennsylvania's agricultural producers – farmers must compete with considerably larger and more capital-intensive national operations in states like California, Arizona, New Mexico, and Wisconsin. According to Hoard's Dairyman, a mere 10,000 dairy farms in the U.S. (or approximately 20% of dairy farms overall) now produce 80% of U.S. milk, with close to 50% of total production dominated by only 2500 of the largest dairies (Geiger, 2013). Dairy ranks as one of the more volatile and marginalized sectors overall. Nationally, for example, the U.S. lost approximately 5000 dairy farms annually between 1997 and 2007, as the average herd size grew rapidly. Farms with over 2000 cows more than doubled between 2000 and 2006, with more than 25% of the nation's milk coming from industrial “mega-dairies” (FWW, 2011).

While Pennsylvania's dairy farms rank fifth nationally in milk commodity sales and fourth in overall production (USDA NASS, 2012), Pennsylvania's small and midsized operations find it increasingly difficult to compete. Those that remain in business face fluctuating and fickle hundredweight prices for fluid milk; prices are set by antiquated government formulas and controlled by a relatively small cadre of commodities traders (FWW, 2011). Dairy producers also face a narrowing set of options to market their milk, so most pool it within large, increasingly consolidated dairy co-operatives. Concomitant with the surge in hydraulic fracturing, Pennsylvania dairy farmers recently experienced falling milk prices, with feed and fuel costs rising precipitously (USDA ERS, 2010–13).

Nearly half of the farmers in our study were dairy farmers, and many others had direct economic connections to dairy through raising feed crops or value-added enterprises. While many full-time small and midsized Pennsylvania dairy and crop producers receive modest federal subsidy supports that mitigate some of the economic challenges confronting small and midsized producers (USDA NASS, 2012; Wise, 2005; EWG, 2012), these subsidies are insufficient to shield them from the blunt forces of the increasingly consolidated and corporately controlled global marketplace. While small and midsized farmers do have access to federal and state farm subsidies (EWG, 2012), their access tends to remain more limited than larger operators. Though a host of community-based, market-based initiatives have arisen in Pennsylvania—from Community Supported Agriculture farms to food hubs to farmers markets to organic and diversified production systems—the overall impact of these initiatives on agriculture and rural development remains modest. While these initiatives offer promise for economic development in Pennsylvania, (e.g. see Brown et al., 2013), most community-based initiatives remain limited in overall scale and directed toward specialty markets (e.g. see Hinrichs, 2010; Lyson et al., 2008).

From this position of economic vulnerability, the operators of small and mid-sized farms in our study felt constrained to sign leases. They found themselves caught in a nexus of natural resource dependence—between the vulnerable agricultural sector on the one hand, and unstable unconventional natural gas production on the other hand. The environmental risks and uncertainties and lack of procedural equity they experience at the intersections of these industries foster an important form of rural environmental injustice.

### 3. Methods & study sites

Our study primarily utilized qualitative methods—interviews, participant observation, and content analysis—to explore the impacts of hydraulic fracturing activity as it intersects with agriculture in rural Pennsylvania.

We selected Bradford, Susquehanna, and Washington counties for our study sites due to a variety of overlapping considerations. First, we identified Pennsylvania counties where there had been simultaneously rapid shifts in production in certain central agricultural sectors (such as dairy) even as these places saw increased natural gas production (Adams and Kelsey, 2012; Center for Rural Pennsylvania, 2014). Once we identified ten counties of interest based on these criteria, we then determined locations of overlapping concentrations of farms and drilling activity in these counties using ArcGIS. Based on these analyses, Bradford, Susquehanna, and Washington Counties emerged as spaces where agricultural and drilling activity overlapped most intensively, and we determined to draw our sample of farmers and institutional experts from those areas.

This allowed us to conduct our fieldwork in counties that Pennsylvania State Extension agents had identified as key locations to study intersections between agricultural and natural gas production, but where little empirical work had been done (Adams and Kelsey, 2012). Indeed, Bradford County saw an 18.8% reduction in cow numbers and a 18.2% reduction in milk production, alongside its 515 wells; Susquehanna County saw a 20% reduction in cow numbers and a 14.1% reduction in milk production, while hosting 186 natural gas wells; and Washington County saw a 18.9% reduction in cow numbers and a 28% reduction in milk production, while hosting 309 natural gas wells (Adams and Kelsey, 2012).

As discussed above, Bradford and Susquehanna Counties' persistent poverty, natural resource dependence, and strong performance in unconventional natural gas production (US Census Bureau 2012; Brasier et al., 2011) also made them important to study from an EJ perspective. Because Washington County is closer to major urban markets, it afforded a relevant comparison: in spite of possessing a more diversified economy (US Census Bureau 2012), it too experienced decreased agricultural productivity, particularly in the dairy sector, and increased natural gas production (Adams and Kelsey, 2012).

After identifying our study sites, we determined that we would interview Pennsylvania State Extension agents working with the agricultural community in these counties. We identified 6 Extension agents working for Pennsylvania State University with related specializations in agriculture, natural gas and energy, and water; all agreed to be interviewed. These initial interviews confirmed the rationale behind our choice to focus on impacts to small and midsized operators, which their data suggested were experiencing under-researched outcomes (Adams and Kelsey, 2012). They also helped us better understand the contentious politics surrounding unconventional natural gas production in Pennsylvania.

For our farm visits and interviews, we focused primarily on farmers of small and midsized operations with less than 500 acres and/or 200 livestock,<sup>13</sup> selecting these farms for several key reasons. First, each of the Pennsylvania State Extension agents we interviewed observed persistent vulnerabilities that were particularly affecting small and midsized farm operations in the state. Second, as discussed above, farmers of small to midsized operations

<sup>12</sup> In Pennsylvania, the average farmer age aligns with the national average (55 years), which is in step with retirement trends, an aging farmer population, and national land transition patterns.

<sup>13</sup> Estimates of farm size were informed in part by USDA characterizations of small and midsize farms in the region, as well as preliminary interviews with expert informants.

tend to be more economically vulnerable, facing an increasingly consolidated agricultural system in the U.S. (Heffernan et al., 1999; Hendrickson et al., 2002; Hauter, 2014). Therefore, while Pennsylvania State Extension agents introduced us to operators of larger farms, and while these larger operators did provide important alternative examples of farmers with more acreage and/or more livestock, we focused on small and midsized farmers and their more pronounced and unique vulnerabilities to procedural inequities and increased environmental risk.

Farms and farmer participants were identified using Pennsylvania State University's AgMap, Local Harvest, and Manta. We additionally used a network sampling strategy to identify interview participants. We asked 50 farmers to be interviewed; 36 small and midsized operators farmers agreed and participated in our study (along with six larger operators who helped us access other farmers in the region). Thirty-three of the farmers of small and midsized operations we interviewed had natural gas activity directly on their land; 31 owned their mineral rights.

We conducted 42 in-depth, semi-structured interviews. In addition to interviews with farmers, 6 interviews were with Penn State Extension agents.<sup>14</sup> Four Extension interviews were conducted over the phone and two were conducted in person, at Extension field offices. All interviews with farmers were conducted on-site and included extensive farm visits and tours of wellpads and other natural gas infrastructure. Interviews lasted 1–2 h and were recorded. We asked farmers questions about their farms, leasing experiences, trust in corporations, and positive and negative experiences with natural gas production. Interviews and field notes were transcribed, analyzed for emergent themes, and then coded and analyzed utilizing NVivo Qualitative Analysis software. Three team members coded interview data independently and discussed coding approaches in three separate and iterative meetings, assuring inter-rater reliability in the way that interview and archival data were interpreted and analyzed.

In addition to farm visits and in-depth interviews, we conducted extensive archival analyses of state records on natural gas extraction activity, leases and lease terms, and development of natural gas regulations and institutional enforcement of those over time. These allowed us to piece together the complex relationships between agriculture and natural gas, exploring change over time.

#### 4. Findings and analyses

Our evidence shows that people operating smaller and midsized farm operators are caught at the nexus of intersecting forms of natural resource dependence. Because farmers in our study experienced compounded forms of vulnerability, they were not positioned to parlay their mineral wealth into power or protection from daily environmental risks or uncertainties. They particularly experienced procedural inequity, since they felt constrained to allow unconventional natural gas production on their land, utilizing it for income they needed to informally subsidize their small and midsize farms. Below, we show how farmers' intersectoral dependencies helped condition environmental injustice.

Farmers in our sample used natural gas lease monies to address economic vulnerabilities they experience as marginalized players

<sup>14</sup> We also conducted six in-depth interviews with larger operators, to begin observing differences between small/midsized and larger operators, thereby assuring validity in our analyses. The larger operators we selected were mentioned by Extension agents as having abundant natural gas production and being important community gatekeepers. A couple of these larger farms had organic dairy operations, so we chose them based on that research interest as well. For purposes of this analysis, however, we focus exclusively on interviews with small and midsized farmers.

in the agriculture sector. Lease monies supplemented their modest farm incomes, providing their households with social safety nets. These funds also allowed them to alleviate debt, maintain future farm operations for their children, and to transition out of dairy farming specifically. While natural gas income provided an initial benefit for their operations, these farmers face a type of devil's bargain: in an effort to save and secure their farming livelihoods, they feel constrained to depend on volatile natural gas markets for income.

One Bradford County dairy farmer explained his position this way:

Farmers now, especially dairy farmers, we are really, really hurting. So a lot of us are looking for any way out. We're doing what we love, and it costs us money to farm. So we finally break down and say 'I'll sign the damn lease. It's a way to save my cows.' And that's been happening more and more.

Another Susquehanna County farmer expressed how he and his neighbors felt that signing natural gas leases was the only way to save their farming operations: "A lot of farmers would have had to go out of business if it wasn't for the gas industry coming in and giving us the money to help with our farms. Otherwise, we all would have lost it."

Our findings demonstrated that owners of small and midsized farms accepted risks to assure much-needed income the industry offered. To support these observations, we offer extensive empirical illustrations of farmers' dependence on both agriculture and natural gas production. Though their mineral rights admittedly enhance their incomes initially and offer some leverage with natural gas companies, we show how this current natural gas boom is far from a boon for operators of Pennsylvania's small and midsized farms.

##### 4.1. Corporate bullying, lack of procedural equity, and environmental risks

Most farmers we interviewed indicated that their mineral rights ownership did not confer adequate participation in the leasing process; they repeatedly reported that corporations were not transparent. Particularly, despite owning their land and often their mineral rights, they found they had little agency over the natural gas industry's access to their land or the environmental impacts, uncertainties, and risks resulting from unconventional drilling on their farmland.

Specifically, farmers lost power over who accessed their land and when. One Susquehanna County organic dairy farmer had a unique institutional perspective on small and midsize farmers' lack of power, given his leadership role in the Pennsylvania Association for Sustainable Agriculture (PASA). He noted farmers' powerlessness and vulnerability in negotiating and enforcing leases with the industry:

The theme power just came up a lot [in my conversations with farmers]. ...[F]armers felt like they didn't have the power, you know, they wanted someone like PASA to be an ally to give them more power...because the gas companies have so much power here and farmers, you know, don't.

In spite of owning mineral rights, farmers did not experience procedural power. Instead, they traded economic vulnerability in the agriculture sector for dependence on the unstable unconventional natural gas sector.

Lack of transparency was a consistent theme within our

interviews. One sustainable dairy farmer noted, “As for the companies themselves, I think the bigger frustration is, they don't tell you what's going on...Yes, we signed the lease, we signed the agreement, but you're [natural gas company] not going to trash my farm.” Another farmer explained: “Well, we believed what they [their leaseholding company] said. We believed they would do what they said, and honor the agreements [leases]. And it's just through time and experience and talking to neighbors, that we see that they don't mean a thing that they say.” We use the term “sustainable” to identify farmers who used either organic and/or holistic methods for livestock care and crop management. These farmers also belonged to the Pennsylvania Association for Sustainable Agriculture and adopted their agricultural practices, including avoiding synthetic chemicals or pesticide use whenever possible. Sustainable methods were used by about two-thirds of our 36 small and midsized operators.

The majority of operators of small and midsized farms we interviewed reported feeling bullied by natural gas companies eager to access their land and minerals, while farmers are given neither the financial support they were promised nor the decision making capacity procedural equity demands. One farmer described the process this way:

We have friends that...haven't gotten paid yet. They haven't gotten any royalty checks and their unit has been in production for almost a year.... Every time we have a question, it's like, 'Oh you didn't send in this form,' or 'We haven't received this or that.' ... It's big money, big corporations. These people have a whole room full of lawyers sitting around with nothing else to do but think of ways to get over on somebody. And they do.... It's the principle of it. It's the deception, the principle and the bullying...by corporations, corporate bullying.

A strong pattern emerged among our interviewees, where 30 out of 36 respondents reported being pressured by company representatives like landmen – rather than participating equitably in decision-making processes. Farmers experienced procedural inequity both when signing leases and during various production phases. A small-scale dairy farmer explained, “We've actually had a landman threaten us here on our property.” In a scenario representative of the interactions many farmers experienced, one dairy producer reported the lack of power he felt in his relations with the company holding his lease: “They're just trying to bulldoze right over us. It was all permission before, and now it's just, 'We're going to buy it from Talisman' – our lease – ‘and then do whatever we want.’ That's what they said....basically Chief is bulldozing right over top of us, and going to do whatever they want no matter what we say.”

Farmers frequently described how this bullying extended to public meetings intended to provide open forums to discuss the industry's rapid growth in Pennsylvania.

One small-scale dairy farmer explained a typical situation:

We organized a meeting at our church to address problems people were having with their leases and land. The meeting, it was filled to capacity. And Chesapeake was supposed to give a presentation and answer people's questions. Instead they were a little less polite about it. Basically they were giving veiled threats, their security guards were there – armed....The meeting was a dismal failure.

Such lopsided interactions with natural gas companies left farmers feeling disempowered, excluded from procedural equity, and exposed to serious environmental risks on their land and in

their communities. A small-scale dairy farmer from Bradford County explained:

If they would just be square and deal with people, treat them with respect, even though (pardon the language) they're screwing everybody. ..But that's not the reality...They don't have to follow the rules. Chesapeake doesn't have to follow the rules. They dump in rivers, they have spills, they're toxic. There was one time, two years ago now, something leaked from a gas truck going down the road...Their [Chesapeake's] response? 'Oh, no, that's not anything harmful, it's minerals, water, something like that.' But they had to dig out the whole road and replace it.

Another farmer described her concern over the environmental damages she, her family, and her employees were exposed to due to unconventional activity on their land:

We understood that when you go in an area and you're extracting natural resources, that there is destruction, there's an inconvenience, and, yes, there are going to be accidents. Things will happen...We knew some water was going to be contaminated, that's the nature of the business...And we were assured and saw the landman's charts, the graphs, the literature and everything else. But it's been completely, completely opposite.

31 of the 36 farmers we interviewed showed us or described damage to their land or experiences of environmental risk. One farmer explained: “What we're most interested in is reclaiming – I'll take you up and show you where they put in the pipeline...it's our hayfield. You should see the disgrace. They put in a temporary waterline down here one year. And it broke. We had frack water all over the friggin' place. They completely destroyed our land.” Other farmers have had spills on their land and lost livestock as a result. One dairy farmer reported:

There have been a few brine spills that happened. There's been a few fines, some of our animals were involved in one of those brine spills. But we didn't even know that it was a brine spill till 2 years later when we read in the paper that there was a miniscule fine for that..As a landowner, if there was a brine spill, DEP [Department of Environmental Protection] should have come to me and said, 'Your cows are in the drinking water area of a brine spill. Did you have any problems?'. Nobody contacted us....Then we had a few heifers that dropped their calves. We didn't know why at the time.

Importantly, some farmers reported that they planned to transition out of farming, not because of natural gas monies, but because of irreparable damage to their farmland and operations. One mid-scale cattle farmer observed:

A lot of people have given up farming because they [the gas companies] weren't careful...For us, they put in water lines and didn't re-seed the hay field properly. That might affect us next year, on the amount of cattle we're able to keep. They don't care. They say, 'Well, you can sell your livestock, and we'll give you money to buy new cows.' Well, you don't understand that, there is a rhythm. If I lose a year, that means I lose the calves that I can't send to market. It means that I can't provide the financial means to feed my cows.

Another Bradford County organic dairy lost their organic certification due to sloppy reclamation by the natural gas company holding their surface and minerals leases. That farmer observed:

“Because of the pipeline, they didn’t seed it back organically...It wasn’t renovated in compliance with requirements to certify organically...they’re supposed to put things back the way it was. We went as far as to give them the name of a guy, a local guy, who can get in organic seed for us. They never contacted that guy. So... we can mark organic certification out for 3 years.”

Though farmers gain initial economic relief by signing leases, they experience significant environmental risk and sacrifice procedural equity to do so. Even when actual damage had not occurred, the uncertainty of environmental risk weighed heavily on some farmers. As one farmer explained,

It’s this uncertainty. Not knowing. Every day when we get up, we’re not sure what’s going to happen. Some people have the illusion they’re gonna become wealthy and maybe if they do contaminate, maybe it’d justify it. But...for us it would be absolutely devastating if they contaminated our water. It would be the end of this business, because we know the procedure they follow when they contaminate water. They bring water buffaloes on your property – a big plastic tank which they or they don’t fill. And you think ‘Uh, guests wouldn’t come here and drink our water or shower in this because the water is poison?!’. So it’s just the uncertainty, constantly not knowing what’s gonna happen that really....[it] weighs heavily daily.

## 4.2. Dependence on natural gas income

### 4.2.1. Supplementing unstable incomes and limited social safety nets

Each of the farmers we interviewed with mineral rights expressed feeling constrained to sign natural gas leases, usually in an effort to stabilize and reinforce their vulnerable farming operations and livelihoods. In many cases, leasing land for natural gas production generated increased income, though farmers frequently voiced concerns over depending on income from another bust-prone industry. When asked why she leased portions of her once-productive farmland to host a wellpad and pipelines, one small-scale sustainable dairy and crop farmer in Susquehanna County exclaimed, “Oh geez, I can make \$200 per acre on a corn crop, and in all likelihood you’re going to make a hell of a lot more on a well pad. While it lasts.”

But some farmers expressed concerns that these initial economic benefits might not outweigh longer-term environmental risks. For example, a small-scale dairy farmer explained: “Like this neighbor of mine said, ‘They sure made a mess out of your hillside ... if you could do it over again, would you do it again?’. ‘Dave,’ I said, ‘I’m gonna make more off that hillside than I ever made in entire life of farming. But no, I wouldn’t do it again!’” Consistently, farmers indicated that income from natural gas production was too appealing to initially reject. However, eventual damage to their land and their inability to control the ways their land was developed and utilized led some farmers to regret their participation.

33 of the 36 farmers we interviewed reported in clear, simple terms that their farming livelihoods now depended on natural gas-related income, due to the instability associated with farming, their lack of safety nets, and the volatility of global commodities markets. One small-scale Susquehanna County dairy and wheat farmer put it simply when he said, “Our livelihood depends on it [natural gas lease monies]!” Another small-scale, sustainable crop farmer in Washington County observed an overall pattern:

Some farmers are able to pay bills that they haven’t been able to. We never have a steady income...It doesn’t work that way. At least we do get paid twice a month instead of once...So if there’s any success with anyone out there...I say good for them!

A wife and husband farming team from Susquehanna County observed that farmers’ newer dependence on natural gas monies fortified longer-term dependencies on agriculture. They explained these community-wide patterns:

Wife: It’s funny because sometimes when we’re driving down we’ll see a house that we know and think, ‘Oh a new roof got built? They must have gotten some gas money’...

Husband: New vehicles, new additions, things like that. I think they hit the mother lode and it wouldn’t have happened any other way...These dirt poor farmers who have nothing, who’ve struggled through all these years – more power to them!

W: When did a quart of milk ever go up in price? Yet the farmers’ expenses continue to go up. The equipment and gas have gone up.

Our interviews showed that farmers use lease income to pay for social safety nets such as healthcare. Thus, farmers’ intersectoral dependence is further compounded, in that their livelihoods and daily quality of life depend on income from the volatile natural gas and agriculture sectors. A Bradford County farmer with multiple wellpads on his midsized organic dairy farm explained the ways natural gas income helps assuage economic vulnerabilities of many Pennsylvania farmers. But we also see his dual dependence; he describes that farmers provide their own safety nets, that agricultural boom and bust cycles give farmers little control over their livelihoods, and that this constrains them to turn to income from natural gas production:

Overall, it’s [the boom in unconventional natural gas production] been overwhelmingly positive for agriculture...First, agriculture is always economically challenged...agriculture goes through up and down cycles, where prices for commodities slide down – and those prices are not set by farmers! Recently, they’ve [prices for organic dairy products] declined the worst in 35 years. We have had up and down economic challenges throughout other portions of our time operating this farm. So, whenever there can be a good source of revenues for farmers, that’s a good thing. The jobs that are related...that the industry has opened up other off-farm opportunities for farm members to work outside of the farm...has been helpful to gain benefits such as health coverage.

Another farmer we interviewed with a midsized operation discussed his reliance on natural gas lease income as a mechanism for coping with his dependence on agriculture. Natural gas income allowed him to provide health insurance for his family and contend with unpredictable, intense storm activity that year. He observed:

This year we lost 90–95% of our crop...Being as I don’t work off the farm, we pay our own health insurance, which is not cheap, you know. We’re responsible for all our bills...I would be working off the farm. And I would probably weigh 82 pounds. So, in our case, financially I don’t know where we’d be without gas money.

The operator of a small-scale, family-run dairy farm we interviewed in Bradford County observed the structural constraints

faced by dairy farmers in a consolidating industry. As he explained, vulnerabilities that farmers feel due to unstable agriculture markets are initially reduced by the financial benefits of unconventional natural gas production:

The vast majority of these family dairies...they welcomed this [natural gas] business. It hasn't been without challenges and distractions, but...[motions around her kitchen]. You can see the map... on the decline of dairy herds over the past 20 years... We've lost 20% of the dairies over the past 5 years, but that is a larger trend that has been steadily occurring over the past 20 years...

Pennsylvania State University Extension agents confirmed how, for farmers of small and mid-scale operations, natural gas monies allowed them to stabilize their operations. One agent, specializing in dairy farming and natural gas development, observed: "They [leases from natural gas development] ...well, it's more money, allows them [small farmers] to pay off their home, get new tractors, build new structures, a variety of things. It's allowed them to stay on the farm. The cash flow allowed them to survive."

While signing natural gas leases allowed the farmers in our study more financial security and freedom while the gas industry boomed, natural resource-based industries, including this one, have strong historical patterns of busting (DePillis, 2015; Kelly, 2014). Financial gains and strategies to provide economic stability are thus temporary. In fact, Lustgarten (2013) shows farmers in this region have dealt with unpaid royalties and other broken agreements with the industry even *before* bust periods affected Bradford and Susquehanna counties. Since farmers signed natural gas leases from positions of existing economic vulnerability, we can see how an intersectoral dependence has been structured via natural gas leases. This has created conditions for rural environmental injustice, particularly procedural inequity and increased exposure to environmental risks and uncertainties, whereby small and midsized farmers are ultimately disadvantaged.

#### 4.2.2. Alleviating debt, saving the farm for future generations

The vast majority of farmers we interviewed had multi-generational perspectives; they wished to hand their livelihoods down to their children or grandchildren. Natural gas income appeared to offer additional safety nets not available solely through agricultural markets or federal subsidies. Lease and royalty monies helped mitigate the vagaries of unstable, volatile agricultural sectors such as dairy, at least for the boom period (Lustgarten, 2013). As one small-scale crop farmer in Washington County observed, "Those [farmers] that...have leases...they have been able to pay down some significant debts from their farms. They have more confidence as to the future." Another small-scale, sustainable dairy and hog farmer in Bradford County expressed his economic constraint and hope that this new stream of income could help him pass his farm on to future generations:

For the area and for the farmers, this [natural gas income] is...a godsend for us because farmers we're getting our brains kicked in, especially the dairy farmers. Yeah, this is probably a godsend for all of us, to be able to make some money, maybe to be able to keep our farms. Keep it in the family and not try and sell it off.

While farmers' strategies were indeed rational – based on expectations of income from natural gas leases signed and paid on by industry during the boom period – as the industry vacillates and certain sub-regions experience busts (Brasier, 2014), these

agreements have been violated (Lustgarten, 2013) and leave farmers with environmental risks and uncertainties (Kelly, 2014).

Thirty-one of the farmers we interviewed saw their new economic relationship with the natural gas industry as instrumental. They often expressed the view that income from leases would allow younger generations to enter into or remain a part of the family farming business. One farmer explained:

People don't realize how far reaching the economics are...They trickle down. Farmers...are good at reinvesting...There's been some young farmers who were able to stay on the farm with their parents because they weren't so economically dependent on the milk check...There's opportunities there that didn't exist five years ago.

Farmers also reported paying off debts from large infrastructural projects that their modest family farms would have otherwise had to pay off over decades, pass on to future generations, or avoid entirely. An operator of a small-scale dairy and livestock farm said: "Over at the buffalo farm, we've been getting [natural gas] royalties for a year and half. And that's paid for the whole barn, in a year and a half...A lot of the royalties for us farm guys...we're able to pay down our debt, we bought new machinery. You have to."

While the income afforded by unconventional natural gas leases created short-term benefits for farmers, and may foster some longer term viability for their farming operations, farmers' leasing decisions represent a devil's bargain tied to structural rural environmental inequity. The natural gas industry is prone to similar patterns of natural resource-based production as agricultural commodity markets – volatility, instability, and shifting political economies (Krannich and Luloff, 1991; Humphrey et al., 1993). Thus, as farmers balance their dependence on agriculture with dependence on natural gas leases to keep their operations viable, they compound their vulnerabilities by depending on yet another volatility-prone industry. While they may expect that income from natural gas will provide reliable incomes and mechanisms for bequeathing their farms to future generations, the scholarship suggests that busts consistently follow booms in NRDCs, even spanning industries (see review above, especially Freudenburg and Gramling, 1998).

Yet farmers' longer-term concerns over bust-prone industries like natural gas failed to outweigh the more immediate need for financial safety nets, offered in the form of a wellpad or gas lease. Even the few farmers we interviewed who did not have wellpads on their land expressed a strong desire to be a part of the boom. A small-scale dairy farmer outside of Washington County asserted:

My brother and I, I'm 50, he's gonna be 52 in the fall. We have no kids that want to take the farm over. The question always is, 'How long do you go?' It's a young man's gig, farming is. And I'm not gonna do it forever, so this would really help us be able to keep the land...Without that [the potential lease or royalty monies], what do we see as the future?...A lot of farmers in the past were forced to sell off the property because if they wanted to retire, they had nothing else. This may stop some of that.

For many of our interviewees, the initial financial security experienced during the natural gas boom outweighed the potential concern over a bust, despite the seeming inevitability of busts following booms.

The industry also encouraged this perception. In many ways, landmen helped shape farmers' perceptions of the natural gas industry and its economic longevity, as they visited farmers' homes multiple times to secure contracts. As other trusted sources like

Pennsylvania State Extension agents lauded benefits of the natural gas industry when discussing leases with farmers, farmers were less likely to consider the risks of engaging with that industry and the (inevitable) bust of a natural resource dependent economic sector like unconventional natural gas extraction.

One operator of a midsized sustainable dairy farm in Bradford County explained his impressions of the industry's potential for longevity when he said:

They're [landmen from natural gas companies] telling us that, if I was your age [talking to 30-year-old interviewer], your grandchildren would still be getting royalties for the land. This is a long-term, 70–80 year happening. There are wells at the present production, which far surpasses anything they expected, that one well alone will be a 20–30 year life. So that's something else. So why sell land? When you have a promise of that coming?

Still, if historic boom and bust cycles of natural resource dependence hold true, this strategy may prove risky over time, especially if farmers pin their retirement plans to volatile agricultural and natural gas prices. One dairy farmer noted their household's vulnerability and highlighted how much his family farm depended on lease and royalty monies from the natural gas industry: "We have no pension. We have our farm. Our farm is what we'll live on when we're old. Now, as long as we have this [gas] income, it [their farm] can go to the next generation." When farmers face both procedural inequities and the inability to avoid dependencies on volatile industries, this represents a unique form of environmental injustice. Farmers therefore take on leases they feel unable to reject and then contend with multiple environmental risks and uncertainties as a result.

#### 4.2.3. Diversifying operations or transitioning out of farming

One benefit that operators of small and midsized Pennsylvania farms associated with signing natural gas lease and royalty monies was that leases allowed them to transition out of labor-intensive dairy operations to different operations, such as raising beef cattle or growing wheat. This trend has also been shown in data on Pennsylvania farmers (Adams and Kelsey, 2012). As one Pennsylvania extension agent explained:

The median age of farmers is in their late 50s...People are thinking about retiring, and about how they can they pass the farm on to the next generation. They don't want to get out of farming, they just want to get out of dairy farming...We're seeing a downward trend in dairy, and...perhaps it's linked to natural gas drilling. People are moving towards [a]...different model of farming. They're doing crop or doing cattle and livestock, rather than dairy milking.

While transitioning to a less labor-intensive agriculture sector brought benefits, it also involved sacrificing procedural equity and taking on the environmental risks and uncertainties of new natural gas operations on their farmland in order to make the transition.

Most farmers we interviewed needed the extra natural gas income to help them exit dairy farming specifically. As a Bradford County dairy farmer described,

Farmers that [have leases] have got more resources to diversify in some areas. If you were a 100 cow dairy farmer, then you're pretty much stuck in that position of having 100 cows. When you have some more resources...you can diversify to the other, less work-heavy areas of farming."

Another Susquehanna County dairy farmer explained:

The average age of a Susquehanna farmer is 55 or 60-plus, and those guys have been milking cows since they were 18. So...with the physical toll it takes on your body, if you can do something less physical and emotional, then they will go for it.

While natural gas leases may provide financial benefits for farmers with mineral rights during boom periods, the long-term implications for their farms, the dairy industry, and particularly small and midsized operators' presence within it in the U.S., remain uncertain. This trend toward intersectoral dependence may create a mechanism whereby these farmers can essentially sell their long-term farming livelihoods to the natural gas industry. Indeed, farmers noticed how these systemic shifts were painfully changing the face of farming itself. One operator of a small Bradford county dairy observed:

Before the gas boom, there were so many dairy farmers. Yeah, they were struggling, they had a hard time making ends meet... But there are so many dairy farmers that as soon as they started getting royalties...they're gone, they're not ever coming back. So that hurts to a degree...more of the big picture as far as milk production...I think it hurts.

While the boom facilitates increased financial security, the above farmer notes that in the long term, farmers may ultimately elect to leave dairying anyway. But by pinning their transition to unstable natural gas royalties, they are vulnerable to the risks of dual dependencies and the environmental injustices they condition.

Many farmers noted the inherent risks in their intersectoral dependence on two unstable industries. One small-scale, Washington County dairy farmer explained:

Naturally, we've all [referring to farmers in the area] had these money problems. We're looking forward to getting royalty payments...That's a great boon. That's a big positive thing here [in this area of Pennsylvania]. But, there...what we've done is make a deal with the devil. Which is what it is. The other thing that's happening economically with the farms...we've got the lease, we got the royalties, and we're not farming anymore...The government with the agriculture bills that they've passed in the past three years – that's the final nail in the coffin for small family farms.

## 5. Discussion and conclusions

Until now, the story of farmers with wellpads in Pennsylvania has been one of economic booms and "shale-ionaires (Lustgarten, 2013; Kelly, 2014). According to this oft-repeated "energy lottery" narrative, farmers have benefitted enormously from the Marcellus Shale boom. On certain counts, this story is certainly accurate, even for farmers of small and midsized operations: unconventional natural gas lease and royalty monies help economically vulnerable farmers supplement modest incomes, pay off debts, diversify and protect their farm livelihoods for future generations, and transition out of less desirable agricultural sectors. The natural gas boom brings welcome relief from pre-existing marginalization.

But as often as they spoke of their windfall, Pennsylvania farmers we interviewed also described feeling constrained to make a "deal with the devil." They lost procedural equity. They complained of "corporate bullying" in the face of large companies with "rooms full of lawyers." They spoke bitterly of feeling

disempowered by the invasive activities of industry on their land. When seeing the impacts to their farms, some regretted their decision to sign leases. Far from the glamorous worlds of the 'shale-ionaires,' these farmers struggle to receive royalty payments (Lustgarten, 2013), face a busting natural gas economy (DePillis, 2015), and contend with abundant environmental risks and uncertainties (Bienkowski, 2015; St. Fleur, 2015).

As our study illuminates, we cannot assume that land ownership, or even mineral rights ownership, confers meaningful participation in farmers' decision making about natural gas operations on their land. Instead, Pennsylvania's small and midsized farmers experience procedural and other environmental inequities related to their participation in the natural gas industry and their growing dependence on those unstable leases. They feel limited by their economically vulnerable position and take on an intersectoral double bind. This double bind means that farmers feel constrained to sign leases but sacrifice procedural equity in the process; they also contend with increased environmental risks and uncertainty from production on or near their land.

While natural gas lease monies allow some farmers to diversify their operations (particularly dairy), they remain locked into a long-term commitment to a new type of volatile cash crop: natural gas. Like the farmers who began growing new strains of rice during the Green Revolution, this crop generates clear, apparent benefits at the same time that it fosters structural dependencies that close off other potentially less destructive rural development options.

Long-term, this structural intersectoral dependence benefits both industries while further limiting the options of already structurally disadvantaged small and midsized farmers in impoverished counties (Bienkowski, 2015; Ogneva-Himmelberger and Huang, 2015). Farmers who are informally subsidized by the natural gas industry may be willing to tolerate narrower and narrower returns for their agricultural operations, or they may transition out of farming entirely (Kelly, 2014). They may be less likely to press for structural changes to unjust conditions within the increasingly corporately concentrated agricultural sector. In short, farmers can be paid to put up and shut up by the natural gas sector.

The natural gas industry garners loyal participation for a relatively small price. As farmers sign leases, they hand over not only access to their land, minerals, and natural gas reserves: they also agree become willing captives on their own land. Farmers wishing to maintain their multi-generational farms, passing them on to future generations, may tolerate considerable indignities to hold on to their farms. In this way, farmers can function as the first line of defense for the industry, disproportionately absorbing with their farmland the environmental impacts that may otherwise affect the larger community. They serve as stewards not only of their own land but also the energy reserves now claimed by the natural gas industry.

At a time when unconventional US shale production booms, we offer here unique, empirical insights into the underexplored rural environmental justice implications of these practices. By linking research in EJ, natural resource dependence, and sociology of agriculture, we show how unconventional natural gas production has created environmental injustices alongside economic development. Rather than assuming all farmers have had similar experiences as 'shale-ionaires,' we show that production outcomes have been exceptionally uneven and shaped by multiple forms of environmental injustice.

We contribute to the literature on environmental justice and offer new evidence about the ways rural communities are impacted by rapid and unconventional energy development. In capturing small and midsized operations' intersectoral dependence on two natural resource-based economic sectors, we also show how this dependence compounds farmers' vulnerabilities, as they rely on

evasive royalty payments (Lustgarten, 2013), sacrifice procedural equity, and contend with multiple environmental risks.

As landowners and beneficiaries of lease payments, clearly the farmers in our study benefit from some resources and privileges that many victims of environmental injustice do not. Nevertheless they contend with compounded environmental and economic risks and procedural inequities that may intensify over time. In much the same way that Appalachian rural farming communities experienced inequities at the hands of the coal mining industry, Pennsylvania farmers represent an important case of rural environmental injustice.

We suggest that these findings would be enhanced through comparative case studies in other locales, where unconventional oil and gas production has also boomed and has typically depended on leasing farmland (e.g. Colorado, Texas, Ohio, North Dakota, California). Since mineral rights laws, regulatory regimes, and biophysical environments vary greatly from one region to the next, it is important to examine different experiences of small and midsized farmers longitudinally, across regions, and across economic boom and bust cycles. Importantly, studying these patterns may help rural communities and individual farmers across the U.S. make informed decisions about their livelihoods on their own terms. Further, our interviews with operators of larger farms indicate that they may experience different environmental justice outcomes, particularly regarding their experiences of procedural justice and treatment of their land by natural gas producers. We encourage more extensive, comparative investigations of experiences for these larger operators. Agriculture and unconventional energy production interact in important and varied ways that need to be researched much more extensively.

## References

- Adams, Riley, Kelsey, Timothy W., 2012. Pennsylvania Dairy Farms and Marcellus Shale, 2007–2010. Marcellus Education Fact Sheet. Penn State Cooperative Extension, University Park, PA.
- Agyeman, Julian, McEntee, Jesse, 2014. "Moving the field of food justice forward through the lens of urban political ecology." *Geogr. Compass* 8 (3), 211–220.
- Alkon, Alison Hope, Agyeman, Julian (Eds.), 2011. *Cultivating Food Justice: Race, Class, and Sustainability*. The MIT Press, Cambridge, MA.
- Allen, Barbara L., 2003. *Uneasy Alchemy: Citizens and Experts in Louisiana's Chemical Corridor Disputes*. MIT Press.
- Altieri, M., Toledo, V.M., 2011. 'The agroecological revolution of Latin America: rescuing nature, securing food sovereignty and empowering peasants'. *J. Peasant Stud* 38 (3), 587–612.
- Arnold, Craig Anthony, 2000. Land use regulation and environmental justice. *Environ. Law Report*. 30 (6), 30ELR 10395.
- Author, 2013. There's no real choice but to sign: neoliberalization and normalization of hydraulic fracturing on Pennsylvania Farmland. *J. Environ. Stud. Sci.* 2013, 1–11.
- Bienkowski, Brian, 6 May 2015. Poor in Pennsylvania? You're Fracked. *Environmental Health News*. Accessed at: <http://www.environmentalhealthnews.org/ehs/news/2015/may/pennsylvania-fracking-environmental-justice-poor-economics>. on September 1, 2015.
- Bowen, Sarah, De Master, Kathryn, 2014. Wisconsin's 'happy cows'? Articulating heritage and territory as new dimensions of locality. *Agric. Hum. Values* 31 (4), 549–562.
- Boxerman, Samuel B., Visser, Joel F., Krantz, Michael, 2013. *Hydraulic Fracturing Regulation in the US: 2013 Update. Practical Law: Multi-Jurisdictional Guide* 2013.
- Brasier, Kathryn J., Filteau, Matthew R., McLaughlin, Diane K., Jacquet, Jeffrey, Stedman, Richard C., Kelsey, Timothy W., Goetz, Stephan J., 2011. Residents' perceptions of community and environmental impacts from development of natural gas in the Marcellus Shale: a comparison of Pennsylvania and New York cases. *J. Rural Soc. Sci.* 26 (1).
- Brasier, K.J., Davis, L., Glenna, L., Kelsey, T., McLaughlin, D., Schaff, K., Babbie, K., Biddle, C., Delessio-Parson, A., Rhubarb, D., 2014. *The Marcellus Shale Impacts Study: Chronicling Social and Economic Change in North Central and Southwest Pennsylvania*. The Center for Rural Pennsylvania.
- Brown, Phil, 2007. *Toxic Exposures: Contested Illnesses and the Environmental Health Movement*. Columbia University Press.
- Brown, Sandra, Getz, Christy, 2008. Privatizing farmworker justice: regulating labor through voluntary certification and labeling. *Geoforum* 39, 1184–1196.
- Brown, S., Getz, C., 2011. Farmworker food insecurity and the production of hunger in California. In: Alkon, A.H., Agyeman, J. (Eds.), *Cultivating Food Justice: Race,*

- Class, and Sustainability. The MIT Press, Cambridge, pp. 121–146.
- Brown, Phil, Mikkelsen, Edwin, 1990. No Safe Place, Toxic Waste, Leukemia, and Community Action. University of California Press, Berkeley.
- Brown, David Louis, Swanson, Louis E., Barton, Alan W., 2003. Challenges for Rural America in the Twenty-first Century. Penn State Press.
- Brown, D.L., Reid, J.N., Deavers, K.L., 1989. "Persistent low-income non-metropolitan areas in the US: Some conceptual challenges for development policy." In: Natural Rural Studies Committee: A Proceedings. Western Rural Development Center, Eugene, OR.
- Brown, Jason P., Goetz, Stephan J., Ahearn, Mary C., Liang, Chyi-lyi (Kathleen), October 18, 2013. Linkages between community-focused agriculture, farm sales, and regional growth. *Econ. Dev. Q.* <http://dx.doi.org/10.1177/0891242413506610>.
- Bryant, Bunyan L., Mohai, Paul, 1992. Race and the Incidence of Environmental Hazards. Westview Press.
- Bullard, Robert D., 1983. Solid waste sites and the black Houston community. *Sociol. Inq.* 53 (2–3), 273–288.
- Bullard, Robert Doyle, 1993. Confronting Environmental Racism: Voices from the Grassroots. South End Press.
- Bullard, Robert, 1994. Dumping in Dixie: Race, Class, and Environmental Quality. Westview Press, Boulder CO.
- Bunker, Stephen, Ciccantell, Paul, 2005. Globalization and the Race for Resources. Center for Rural Pennsylvania, 2014. "Establishing a Baseline for Measuring Agricultural Changes Related to Marcellus Shale Development." Marcellus Shale Impacts Report no. 9 accessed 10.03.15. <http://www.rural.palegislature.us/documents/reports/Marcellus-Report-9-Agriculture.pdf>.
- Cooley, Heather, Donnelly, K., 2012. "Hydraulic Fracturing and WaterResources: Separating the Frack from the Fiction." Pacific Institute, Oakland, CA, USA. [http://www.pacinst.org/wp-content/uploads/2013/02/full\\_report35.pdf](http://www.pacinst.org/wp-content/uploads/2013/02/full_report35.pdf).
- Colborn, T., Kwiatkowski, C., Schultz, K., Bachran, M., 2011. Natural gas operations from a public health perspective. *Hum. Ecol. Risk Assess* 17 (5), 1039–1056.
- Coleman-Jensen, Alisha, Nord, Mark, Singh, Anita, 2013. Household Food Security in the United States in 2012. USDA Economic Research Service, Economic Research Report #155.
- Corburn, J., 2005. Street Science: Community Knowledge and Environmental Health Justice. The MIT Press, Cambridge, MA.
- DeNaves-Walt, Carmen, Proctor, Bernadette D., 2014. Income and Poverty in the United States: 2013. US Census Bureau, US Department of Commerce. Accessed at: <https://www.census.gov.edgekey-staging.net/content/dam/Census/library/publications/2014/demo/p60-249.pdf>. Retrieved on 10 September 2015.
- DePillis, Lydia, 2015. The Boom-proof Economy: How to Handle a Fracking Bust. The Washington Post. (Part 5 of series.) January 15. Accessed at: <http://www.washingtonpost.com/news/storyline/wp/2015/01/15/the-boom-proof-economy-how-to-handle-a-fracking-bust/>. Retrieved on August 25, 2015.
- Edelman, Marc, September 14–15, 2013. Food sovereignty: forgotten genealogies and future regulatory challenges. In: Food Sovereignty: a Critical Dialogue International Conference. Yale University. Conference Paper #72.
- Energy Information Administration (EIA), 2012. Number of Producing Gas Wells. Accessed at: [https://www.eia.gov/dnav/ng/ng\\_prod\\_wells\\_s1\\_a.htm](https://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm). Retrieved beginning on 12 April 2012.
- Energy Information Administration (EIA), 2015a. U.S. Remained Largest Producer of Petroleum and Natural Gas Hydrocarbons in 2014. April 7. Accessed at: <http://www.eia.gov/todayinenergy/detail.cfm?id=20692>. Retrieved Septmeber 2, 2015.
- Energy Information Administration (EIA), 2015b. Drilling Productivity Report. August 10, 2015. Accessed at: <http://www.eia.gov/petroleum/drilling/#tabs-summary-2>. Retrieved on September 9, 2015.
- England, L., Albrecht, S., 1984. "Boomtowns and social disruption." *Rural Sociol* 49, 230–246.
- Environmental Protection Agency (EPA), 2012. "Environmental Justice Analysis in support of the National Pollutant Discharge Elimination System (NPDES) General Permits for Oil and Gas Exploration Facilities." U.S. Environmental Protection Agency, Region 10. Accessed at: [http://www3.epa.gov/region10/pdf/permits/npdes/ak/arcticgp/Environmental\\_Justice\\_Analysis\\_Beaufort\\_Chukchi\\_General\\_Permits.pdf](http://www3.epa.gov/region10/pdf/permits/npdes/ak/arcticgp/Environmental_Justice_Analysis_Beaufort_Chukchi_General_Permits.pdf). Retrieved on 10 September 2015.
- Environmental Working Group, 2012. Farm Subsidies Database (accessed 05.03.15.). <http://farm.ewg.org/index.php>.
- Food and Water Watch, March 2011. Consolidation and Price Manipulation in the Dairy Industry. Fact Sheet (accessed 03.02.15.). <http://www.foodandwaterwatch.org/factsheet/dairy-consolidation-price-manipulation/>.
- Foster, Bellamy, John, 1999. "Marx's theory of metabolic rift: classical foundations for environmental sociology". *Am. J. Sociol* 105 (2), 366–405.
- Freudenburg, William R., 1992. Addictive economies: extractive industries and vulnerable localities in a changing world economy. *Rural Sociol.* 57 (3), 305–332.
- Freudenburg, William R., Frickel, Scott, 1994. Digging deeper: mining-dependent regions in historical perspective. *Rural Sociol.* 59 (2), 266–288.
- Freudenburg, William R., Gramling, Robert, 1998. Linked to what? Economic linkages in an extractive economy. *Soc. Nat. Resour.* 11 (6), 569–586.
- Freudenburg, W.R., Pastor, S.K., 1992. NIMBYs and LULUs: stalking the syndromes. *J. Soc. Issues* 48, 39–61. <http://dx.doi.org/10.1111/j.1540-4560.1992>.
- Frickel, Scott, Freudenburg, William R., 1996. Mining the past: historical context and the changing implications of natural resource extraction. *Soc. Probl.* 444–466.
- GAO, US, 1983. Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status of Surrounding Communities. US General Accounting Office, Gaithersburg, MD.
- Geiger, Corey, February 4, 2013. Milk production and dairy farms continue to consolidate. Hoard's Dairyman. Accessed at [http://www.hoards.com/blog\\_milk-production-dairy-farms](http://www.hoards.com/blog_milk-production-dairy-farms) Retrieved on 10 September 2015.
- Glipo, A., Pascual Jr., F.G., 23rd-27th February 2007. Food Sovereignty Framework, paper used in, Nyéléni 2007—Forum for Food Sovereignty. Sélingué, Mali. Retrieved 10 September 2015, from: <http://www.nyeleni.org/spip.php?article89>; [http://www.nyeleni.org/IMG/pdf/FoodSovereignty\\_Framework.pdf](http://www.nyeleni.org/IMG/pdf/FoodSovereignty_Framework.pdf).
- Gilbert, Jess, Sharp, G., Felin, S., 2002. The loss and persistence of black-owned farms and farmland: review and implications. *South. Rural Sociol.* 18 (2), 1–30.
- Granovetter, Mark, 1985. "Economic action and social structure: the problem of embeddedness". *Am. J. Sociol* 91 (3), 481–510.
- Harrison, Lindsey, Jill, 2006. 'Accidents' and invisibilities: scaled discourse and the naturalization of regulatory neglect in California's pesticide drift conflict." *Polit. Geogr* 25 (5), 506–529.
- Harrison, Lindsey, Jill, 2011. Pesticide Drift and the Pursuit of Environmental Justice. MIT Press.
- Hauter, Wenonah, 2014. Foodopoly: the Battle over the Future of Food and Farming in America. The New Press.
- Heffernan, B., 1999. "Consolidation in the food and agriculture system." Report to the National Farmers Union.
- Hendrickson, M., Heffernan, W., 2002. Opening spaces through relocalization: locating potential resistance in the weaknesses of the global food system. *Sociol. Rural* 42, 347–369.
- Hinrichs, C. Clare, 2010. Sustainable food systems: challenges of social justice and a call to sociologists. *Sociol. Viewp.* 26 (2), 7–18.
- Hofrichter, R., 1993. Toxic Struggles: the Theory and Practice of Environmental Justice. New Society Publishers, Philadelphia, PA.
- Holmes, Seth, 2013. Fresh Fruit, Broken Bodies: Migrant Farmworkers in the United States. University of California Press.
- Hooks, Gregory, Smith, Chad L., 2004. The treadmill of destruction: national sacrifice areas and native Americans. *Am. Sociol. Rev.* 69 (4), 558–575.
- Hooks, Gregory, Smith, Chad L., 2005. Treadmills of production and destruction threats to the environment posed by militarism. *Organ. Environ.* 18 (1), 19–37.
- Howard, Ph, 2009. "Consolidation in the North American organic food processing sector, 1997 to 2007." *Int. J. Sociol. Agric. Food* 16 (1), 13–30.
- Howard, Phil, 2016. Concentration and Power in the Food System: Who Controls what We Eat? Bloomsbury Academic Press (forthcoming).
- Hudgins, Anastasia, Poole, Amand, 2014. "Framing fracking: private property, common resources, and regimes of governance." *J. Polit. Ecol* 21, 222–348.
- Humphrey, C.R., et al., 1993. "Theories in the study of natural resource-dependent communities and persistent rural poverty in the United States." Pp. 136–172. In: Poverty, R.S.T.F.o.P.R. (Ed.), Persistent Poverty in Rural America. Westview Press, Boulder, CO.
- Hurley, A., 1995. Environmental Inequalities: Class, Race, and Industrial Pollution in Gary, Indiana. Univ. of NC Press, North Carolina.
- Ishiyama, Noriko, 2003. Environmental justice and American Indian tribal sovereignty: case study of a land-use conflict in Skull Valley, Utah. *Antipode* 35 (1), 119–139.
- Jacquet, J.B., 2014. The rise of 'private participation' in the planning of energy projects in the rural United States. *Soc. Nat. Resour.* 231–245.
- Kelly, Sharon, 2014. Hard Times in a Boom Town: Pennsylvanians Describe Costs of Fracking. DeSmog Blog. December 2, 2014. Accessed at: <http://www.desmogblog.com/2014/12/02/hard-times-boom-town-pennsylvania-residents-describe-costs-fracking>. Retrieved on August 27, 2015.
- Krannich, Richard S., Luloff, Albert E., 1991. Problems of resource dependency in US rural communities. *Prog. Rural Policy Plan.* 5–18.
- Kuletz, Valerie, 1998. The Tainted Desert: Environmental Ruin in the American West. Psychology Press.
- Kuletz, Valerie, 2001. Invisible spaces, violent places: cold war nuclear and militarized landscapes. In: Peluso, Nancy Lee, Watts, Michael (Eds.), Violent Environments, pp. 237–260.
- Lake, R.W., 1996. Volunteers, nimbys, and environmental justice: dilemmas of democratic practice. *Antipode* 28, 160–174. <http://dx.doi.org/10.1111/j.1467-8330.1996.tb00520.x>.
- Lavelle, M., Coyle, M., 1992. Unequal protection: the racial divide in environmental law. *Natl. Law J* 15, S1–S12.
- Lerner, Steve, 2005. Diamond: a Struggle for Justice in Louisiana's Chemical Corridor. The MIT Press, Cambridge, MA.
- Leventhal, Gerald S., 1980. What should be done with equity theory? Springer, US.
- Lustgarten, Abraham, 2013. Unfair Share: How Oil and Gas Drillers Avoid Paying Royalties. ProPublica. August 13. Accessed at: <http://www.propublica.org/article/unfair-share-how-oil-and-gas-drillers-avoid-paying-royalties>. Retrieved on August 25, 2015.
- Lyson, Tom, Stevenson, Steve, Welsh, Rick, 2008. Food and the Mid-level Farm: Renewing an Agriculture of the Middle. The MIT Press, Cambridge, MA.
- Malin, Stephanie A., 2015. The Price of Nuclear Power: Uranium Communities and Environmental Justice. Rutgers University Press, New Brunswick, NJ.
- Malin, S., Petrzalka, P., 2011. "Community development among toxic tailings: an interactional case study of extralocal institutions and environmental health." *Commun. Dev.* <http://dx.doi.org/10.1080/15575330.2011.604424>.
- Malin, Stephanie A., Petrzalka, Peggy, 2010. Left in the dust: Uranium's legacy and victims of mill tailings exposure in Monticello, Utah. *Soc. Nat. Resour* 23 (12), 1187–1200.
- McKenzie, L.M., Guo, R., Witter, R.Z., Savtiz, D.A., Newman, L.S., Adgate, J.L., 2014.

- Birth outcomes and maternal residential proximity to natural gas development in rural Colorado. *Environ. Health Perspect* 122, 412–417. <http://dx.doi.org/10.1289/ehp.1306722>.
- Mint Press News, 1 December 2015. Livestock Fall Ill in Fracking Regions. Accessed at: <http://www.mintpressnews.com/livestock-falling-ill-in-fracking-regions/211720/>. Retrieved December 5, 2015.
- Mohai, Paul, Pellow, David, Timmons Roberts, J., 2009. Environmental justice. *Annu. Rev. Environ. Resour.* 34, 405–430.
- Moore, Patricia, Pastakia, Firuza, 2007. Environmental Justice and Rural Communities: Studies from India and Nepal. IUCN: The World Conservation Union.
- Novotny, P., 1998. "Popular Epidemiology and the Struggle for Community Health in the Environmental Justice Movement," pp. 137–158. In: Faber, Daniel (Ed.), *The Struggle for Ecological Democracy: Environmental Justice Movements in the United States*. Guilford Press, New York.
- Ogneva-Himmelberger, Yelena, Huang, Liyao, June 2015. Spatial distribution of unconventional gas wells and human populations in the Marcellus Shale in the United States: vulnerability analysis. *Appl. Geogr.* 60, 165–174.
- Pellow, David N., 2001. Environmental justice and the political process: movements, corporations, and the state. *Sociol. Q.* 42 (1), 47–67.
- Pellow, David Naguib, 2002. *Garbage Wars: the Struggle for Environmental Justice in Chicago (Urban and Industrial Environments)*. MIT Press, Cambridge.
- Peluso, Nancy Lee, Humphrey, Craig R., Fortmann, Louise P., 1994. The rock, the beach, and the tidal pool: people and poverty in natural resource-dependent areas. *Soc. Nat. Resour.* 7 (1), 23–38.
- Perry, Simona, 2012. "Development, land use, and collective trauma: the Marcellus Shale gas boom in rural Pennsylvania. *Culture Agric. Food Environ* 34 (1), 81–92.
- Pulido, Laura, 1996. A critical review of the methodology of environmental racial research. *Antipode* 28 (2), 142–159.
- Roberts, J. Timmons, Toffolon-Weiss, Melissa M., 2001. *Chronicles from the Environmental Justice Frontline*. Cambridge University Press.
- Salkin, Patricia, May 2006. Intersection between environmental justice and land use planning. *Sustain A J. Environ. Sustain. Issues*. Spring/Summer 2010: 22. Planning and Environmental Law, Albany Law School Research Paper No. 10–07.
- Schafft, Kai A., Borlu, Yetkin, Glenna, Leland, 2013. The relationship between Marcellus Shale Gas development in Pennsylvania and local perceptions of risk and opportunity. *Rural Sociol.* 78 (2), 143–262.
- Schafft, Kai A., Glenna, Leland L., Borlu, Yetkin, Green, Brandn Q., 2014. Local impacts of unconventional gas development within Pennsylvania's Marcellus Shale Region: gauging boomtown development through the perspectives of educational administrators. *Soc. Nat. Resour.* 27 (4), 389–404.
- Shrader-Frechette, Kristin, 2002. *Creating Equity, Reclaiming Democracy*. Oxford University Press, New York.
- Special Issue of *Agricultural History* (77, 2). In: Gilbert, Jess (Ed.), 2003. *Minority Land and Community Security*.
- St. Fleur, Nicholas, 4 May 2015. Chemicals used in fracking are detected in Pennsylvania drinking water. *N. Y. Times* pp. A-15.
- Stedman, R., Jacquet, J., 2011. Natural gas landowner coalitions in New York State: emerging benefits of collective natural resource management. *J. Rural Soc. Sci.* 26 (1), 62–91.
- Szasz, Andrew, Meuser, Michael, 1997. Environmental inequalities: literature review and proposals for new directions in research and theory. *Curr. Sociol.* 45 (3), 99–120.
- Sze, Julie, London, Jonathan K., 2008. Environmental justice at the crossroads. *Sociol. Compass* 2 (4), 1331–1354.
- Taylor, Dorceta E., 2000. The rise of the environmental justice paradigm injustice framing and the social construction of environmental discourses. *Am. Behav. Sci.* 43 (4), 508–580.
- United Church of Christ Report, 1987. "Toxic wastes and race in the US: a national report on the racial and socioeconomic characteristics of communities with hazardous waste sites." Public Data Access, NY.
- USDA. "Geography of Poverty." (accessed 09.06.14.) <http://www.ers.usda.gov/topics/rural-economy-population/rural-poverty-well-being/geography-of-poverty.aspx>.
- USDA Economic Research Service. "Farm and Wealth Statistics: Pennsylvania." (accessed 10.03.15.) [http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/returns-to-operators,-us-and-state.aspx#P80a07f8ba91b4b31918c3be5ae1eca3b\\_2\\_160iTOR0x38](http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/returns-to-operators,-us-and-state.aspx#P80a07f8ba91b4b31918c3be5ae1eca3b_2_160iTOR0x38).
- USDA NASS, 2012. *Census of Agriculture Highlights, "Dairy, Cattle, and Milk Production."* Retrieved on March 15, 2015 at. [http://www.agcensus.usda.gov/Publications/2012/Online\\_Resources/Highlights/Dairy\\_Cattle\\_Milk\\_Prod/Dairy\\_Cattle\\_and\\_Milk\\_Production\\_Highlights.pdf](http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Dairy_Cattle_Milk_Prod/Dairy_Cattle_and_Milk_Production_Highlights.pdf).
- Wilber, Tom, 2012. *Under the Surface: Fracking, Fortunes, and the Fate of Marcellus Shale*. Cornell University Press.
- Willow, Anna J., Wylie, Sara, 2014. Politics, ecology, and the new anthropology of energy: exploring the emerging frontiers and hydraulic fracturing. *J. Political Ecol.* 21, 222–236.
- Wise, Timothy A., March 2005. *Understanding the Farm Problem: Six Common Errors in Presenting Farm Statistics*. Global Development and Environment Institute Working Paper No. 05-02.
- Wood, Spencer D., Gilbert, Jess, Spring 2000. Returning African-American farmers to the land: recent trends and a policy rationale. *Rev. Black Political Econ.* 27 (4), 43–64.