



Original research article

## Tradeoffs, balancing, and adaptation in the agriculture-oil and gas nexus: Insights from farmers and ranchers in the United States



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## ABSTRACT

This paper seeks to expand an emerging, multi-disciplinary body of work about tradeoffs in the agriculture-oil and gas nexus by offering evidence of the ways that farm and ranch operators experienced and negotiated costs and benefits of hosting oil and gas in three U.S. oil and gas plays. We report results of mail survey sent to landowners in four rural counties in three U.S. oil and gas regions (Marcellus, Powder River Basin and Bakken) and specifically data from farmers and ranchers about perceptions and experiences of the agriculture-oil and gas nexus ( $n = 96$ ). The data provided through closed- and open-ended questions suggest, from the perspective of those hosting energy infrastructure on farms and ranches, oil and gas development has enhanced agriculture operations and rural livelihoods but is not without negative impacts or tradeoffs. We introduce the balancing act as a useful framework for considering tradeoffs associated with hosting extractive industries as it allows space for the “balance” between economic activities to be impossible, aspirational or achievable. The study observes that mechanisms through which positive and negative effects operate vary according to agricultural context. Implications for research and practice in the agriculture-energy nexus are discussed.

## 1. Introduction

Approximately 35% of the total agricultural acreage in the United States is located in counties with shale development [1], making the scope of the overlay of onshore oil and gas and agricultural land uses vast. Oil and gas developers rely on agricultural lands to locate infrastructure. In return, farmers and ranchers experience a range of benefits and costs, both implicit and explicit, from energy development. However, the degree of alignment between agriculture and contemporary modes of oil and gas production as overlapping resource development strategies remains an open question in the literature [2,3]. Studies confirm economic benefits and mixed demographic outcomes in rural areas [4,5]. On the other hand, a growing body of evidence documents disruption of rural livelihoods, environments, and quality of life in the context of onshore unconventional oil and gas development booms [3,6–8].

That all energy systems imply tradeoffs between societal costs and

benefits is a standard trope of energy research [9–11]. And the notion of tradeoffs is certainly germane in the case of the farms and ranches that “host” oil and gas infrastructure. This paper seeks to expand an emerging, multi-disciplinary body of work about tradeoffs in the agriculture-oil and gas nexus by offering evidence of the ways that farm and ranch operators experienced and negotiated costs and benefits of hosting oil and gas in three U.S. oil and gas plays, with a particular interest in practical adaptations by farmers and ranchers. Focusing on farm business and on-farm activities, we conceptualize the agriculture-oil and gas nexus in terms of a balancing act: the idea, suggested by the literature and our research, that many farm and ranch operators pursue strategies that seek to maximize benefits and minimize costs of development and that the particulars of this balancing act vary in different geographic contexts. The paper has two linked objectives: 1) to provide scholarly audiences with descriptive and comparative data that can inform hypotheses and frameworks for further research about oil and gas development for farm and ranch operations; and 2) to inform regulators,

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policy makers, industry and advocates for agriculture about the range of experiences in the agriculture-oil and gas overlay in three distinct regions of the United States.

Specifically, we share data collected in a long-format mail survey sent to a random sample of 1000 rural landowners in four different U.S. counties with extensive oil and gas development activity (two in the Bakken, one in the Powder River Basin<sup>1</sup>, and one in the Marcellus). We organize our analysis around three concerns: What are the perceived positive and negative effects of oil and gas development on farms and ranches? How do they differ among distinct agriculture-oil and gas geographies? What strategies have farm and ranch operators used to respond and adapt to impacts from oil and gas activities?

The paper begins with a brief summary of the agriculture-oil and gas nexus grounded in recent scholarly literature. The next section describes our data collection and analysis approach. We then report findings in three general categories: observations of major geographic differences in the agriculture-oil and gas nexus, the impacts of unconventional oil and gas development on farm and ranch operators, and the adaptations they report having made in response.

## 2. The agriculture-unconventional oil and gas nexus

Beginning in the early 2000s, onshore gas and oil production in unconventional geologic formations (hereafter UOG) increased dramatically in response to multiple drivers including market signals and technological innovation [12]. Since agricultural operators own the majority of rural land in the United States [13], farmers and ranchers were primary local stakeholders in the surge of UOG development. Our study focuses on this agriculture-UOG nexus, which we define as the geographies in which agriculture and onshore oil and gas development (well pads and/or associated infrastructure) overlap as surface land uses.

Several different bodies of work contribute perspectives on experiences and outcomes of the agriculture-UOG nexus. These include statistical assessments of employment, income, and demographic outcomes in rural areas that draw on large datasets; environmental science studies focused on land, air and water impacts of UOG; survey and interview-based assessments of rural community experiences and impacts, often focused on explaining differences in outcomes or perspectives within and across social or stakeholder groups; and finally in-depth case study engagements with the concerns and issues emergent in specific agriculture-oil and gas landscapes.

Numerous statistical studies of economic and demographic effects of the UOG boom in rural areas that have asked whether rural communities are better or worse off for their participation in energy booms have produced mixed results. Taken together, the studies suggest that the oil and gas boom to date is neither an outright resource curse in rural areas [4,14–16], nor adequately dramatic to “reverse ...[the] long-run, structural problems” facing isolated rural economies ([17]: 235).

Economic studies also show that energy development has benefitted agriculture operations directly by providing supplemental income in the form of lease and/or surface-use, bonus, and royalty payments, albeit in a highly uneven pattern across the United States. In 2014, total private royalty payments in all U.S. shale plays were \$39 billion [18] and approximately 12% of farms in states with shale development

received payments from royalties and/or lease payments with an average amount of \$66,000 [1]. The average was substantially larger for agricultural operations in major shale plays: farms in North Dakota (Bakken shale play) received an average \$157,409 and Pennsylvania farms (Marcellus shale play) received an average \$157,070 [1]. Notably, not every landowner receives windfall payments. For landowners in areas that have had previous energy development and in areas of the West with public mineral ownership, estates are more likely to be “split,” meaning their mineral rights are separated from their surface rights, limiting their financial gains from energy development [13,19].

On the cost side of the equation, environmental and social science studies confirm that oil and gas development can impose costs on farm and ranch operators at both the property and the landscape scale. At the property scale, studies have documented topsoil and/or subsoil compaction [20,21], the introduction of invasive species [22,23], brine spills [24], and livestock losses [25]. Much of the emerging research on environmental impacts of UOG underscores an important feature of the industry in the United States: the tendency for regulatory approaches to follow, rather than pre-empt, the emergence of environmental problems and the science necessary to understand and mitigate them [26–29]. This policy environment puts farm and ranch operators on the frontlines of documenting and responding to novel or emerging forms of environmental damage associated with UOG [8].

An important group of studies explores the agriculture-oil and gas nexus from the perspective of rural landowners and farmers and ranchers through surveys and/or in-depth qualitative approaches. The closest parallel to the work described in this paper is McGranahan et al.’s [11] survey of rural residents in 6 counties in western North Dakota which focuses on documenting the range of perceived impacts and testing for their distribution and representation across stakeholder groups. Among farm and ranch operators, the study identifies concerns about impacts from dust on crop productivity and livestock well-being, a priority on soil conservation and effective reclamation using existing policies and practices, and costs to farm and ranch operators of time they invested in “babysitting” industry.

Survey work continually finds that perceived economic benefits and/or experience in or with extractive industries make rural residents more likely to tolerate oil and gas activity [30–35]. Research in the Northern Great Plains and Interior West points to a tendency for rural landowners to adopt a pragmatic and accommodating approach toward industry, as in the case of a low perception of risk from brine spills on Montana farmland [36] or farmers initiating a ‘troubleshooting’ rather than an oppositional approach to solving reclamation issues in North Dakota [8]. The dynamics underlying farmer accommodation of UOG impacts are likely far more complicated than survey work can address. A few in-depth case studies emphasize how structural political-economic inequalities leave landowners with little choice but to accommodate industry [3,37].

Studies of formal organization in response to UOG impacts by farmers and ranchers in the United States are few in number. Jacquet and Stedman [38] observe benefits of collective organizing among rural landowners in New York State in response to a flurry of leasing activity by landmen in a single geographic area. In contrast, Jacquet [39] points to a trend of “private participation” in which individual landowners and industry negotiate the siting and negotiation of energy facilities directly. Eaton and Kinchy [40] emphasize that failure to mobilize in rural areas should not be equated with consent, although they extrapolate from a very limited number of interviews. Smith and Haggerty [8] describe the tensions in a North Dakota landowners’ organization as they work to mitigate undesired impacts from development by employing an accommodating strategy with industry while continuing to advocate for landowners and avoid industry capture.

Taken together, the existing literature on the agriculture-UOG nexus clearly demonstrates several key trends upon which this study builds. First, other than those directly employed in UOG industry, few private parties experience the tradeoffs embodied in UOG development as

<sup>1</sup> The Powder River Basin experienced a boom in coalbed methane extraction between 1998 and 2008. Although coalbed methane does not meet standard geologic criteria for unconventional sources, the pace and scale of development and the extensive infrastructure necessary for development make a CBM boom very similar to an unconventional boom in terms of surface activities. The landowners of the PRB fit within this sample due to the reliance on agricultural activities, specifically livestock production, in the Basin and the region’s rural geography.

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