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A conceptual model of the socioeconomic impacts of unconventional fossil fuel extraction

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ABSTRACT

As global energy demand increases, the rapid expansion of the unconventional fossil fuel sector has triggered an urgent need for social, economic and policy research to understand and predict how this sector affects host communities and how governance systems can respond to changes presented by this sector. In response to this need, this paper addresses three linked objectives. The first is to review the literature on regional impacts of energy extraction, presented in the form of a framework of hierarchical effects. The second is to consider how these are playing out differently in the context of conventional compared with unconventional fossil fuels. The third is to draw attention to the institutional avenues for addressing these impacts, including an overview of the lessons from existing research on the human and policy dimensions associated with conventional energy industries. In particular, we consider the importance of multi-stakeholder dialog, which plays an important role in how regions respond to the challenges brought about through extractive industries. Overall, we demonstrate that experiences from conventional energy development provide a useful starting point for navigating the human and policy dimensions of unconventional energy for host communities and discuss how these experiences differ when unconventional energy seeks to co-exist with other land uses such as agriculture. The paper draws attention to the dispersed nature of impacts (positive and negative) and how this may shape winners and losers from unconventional energy development, particularly in regions with pre-existing land uses such as agriculture.

1. Introduction

Global demand for energy continues to expand and has raised important questions as to how global society will meet the growing need for energy (Kerschner et al., 2013). Within this context, substantial interest and concern has developed in the domain of 'unconventional' fossil fuels. Some authors have claimed that the extraction of unconventional energy through 'fracking' is socially problematic (Kerschner et al., 2013). Others have observed that 'fracking' represents a convenient catch all for overly-simplistic negative connotations (Evensen et al., 2014). Economists who have examined industry-funded reports about the economic benefits of shale gas have found these to be exaggerated (Kinnaman, 2011). Of particular interest has been a focus on how the socio-economic effects (both positive and negative) are distributed between local and state scales, which are likely to vary on a case-by case basis (Barth, 2013). For these reasons, concerns have been raised about the potential for asymmetrically allocating the costs and benefits of extractive industries across regions in what some consider to be a 'within country' resource curse effect (Cust and Poelhekke, 2015). In this paper we extend this body of thinking by firstly synthesising knowledge on the regional impacts of energy extraction in general, then proceeding to consider how regional impacts are playing out differently in the context of conventional compared with unconventional fossil fuels, drawing on a review of the rapidly-emerging body of case studies, many of which have been published since Barth (2013) exploratory review. Moreover, we consider some of the factors which help explain the differences between case studies, focusing on the importance of governance arrangements.

Diverse environmental concerns have been raised about unconventional fossil fuel development. These include general concerns such as the threat of increased invasive pests, loss of wildlife and reduced air quality (Bergquist et al., 2007; Brasier et al., 2011). They also include specific concerns, held by farmers and environmentalists, about land subsidence and the risks of damage to aquifers by raising salts to the surface and pollution

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through the use of chemical additives in gas extraction (Lawrence et al., 2013). On the other hand, part of the rationale for supporting the expansion of unconventional gas put forward by the business and policy community has been that it may serve as a 'transition' fuel, as a step from more carbon intensive fuels such as coal to low carbon energy such as wind and solar (Kargbo et al., 2010). However, a widely discussed topic is whether the full life cycle of carbon emissions of shale gas remain lower than those for coal with particular concern over the role of fugitive methane emissions which are many times more potent greenhouse gases compared to carbon dioxide (Brandt et al., 2014; Vickas et al., 2015). In contrast to these concerns, it has been observed that, following the development of shale energy in the USA, net carbon emissions reduced over the period 2007–2012. Furthermore, there is a suggestion that the development of the shale industry has had a higher-level effect, by way of legitimising policy discussion in the USA over emissions. In particular, the industry has made it easier for US policy makers to overcome resistance to reducing carbon emissions, at least in part because emission reduction may be more compatible with economic growth than previously thought (Bang, 2015).

1.1. An expanding global industry

Unconventional fossil fuels, and in particular shale gas, have grown substantially since the 1990s in response to changes in drilling technology and fracturing (fracking) techniques. Much of this development has occurred in the USA, where increasing domestic natural gas extraction has been a major component of policies aimed at increasing energy self-sufficiency (Stedman et al., 2012; Gunter et al., 1997). Unconventional natural gas is methane trapped in geological formations including shale, coal seams and tight rock formations (Law and Spencer, 1993; Wright, 2012). While 'tight gas' remains in early exploratory phases, extraction of methane from shale formations and coal seams occurs in several countries including the USA, Canada, Australia, India and China, with recognized potential in Argentina, Austria, Brazil, Germany, Mexico, Norway, Poland, Romania, Sweden, Turkey and the UK (Schulz et al., 2010; Selley, 2005; Weijermars, 2013; Wiśniewski, 2011; Ross and Bustin, 2007; Wright, 2012).

While these issues raise further questions for research as to the appropriateness of unconventional energy development, we nonetheless observe that this type of industry has expanded rapidly in recent years and continues to do so as global energy demand continues to grow rapidly (Kerschner et al., 2013). Unconventional shale gas is already extracted in substantial volumes at the Marcellus and Barnett shales of the USA, with growing or foreseen production in many countries across the globe which have rich endowments. Fig. 1 shows the potential footprint of unconventional energy extraction and how it overlaps with established human settlements and croplands, demonstrating the potential conflict that may arise when resource governance issues and potential compensation are not planned for carefully (Cust and Poelhekke, 2015).

Historically, much of the socio-economic literature concerned with fossil fuels has focused on the broader macro-economic effects of minerals and energy-led economic development calculated at the national scale, such as the widely-recognised phenomenon summarised as the 'Dutch Disease' (Larsen, 2006; Reeson et al., 2012). The macro-economic effects of unconventional fossil fuels have also been noteworthy for national energy markets in places such as the USA and Australia, with broader implications for the global energy system resulting from changes to supply generated in different regions of the world (Johnson and Boersma, 2013; Simshauser and Nelson, 2015). While acknowledging these impacts, our focus in this paper is on sub-national effects. As Fig. 1 demonstrates, the differences within countries are at least as relevant as the differences between countries. On this basis, the focus of this paper is to unpack the local and community impacts of the new extractive industries. Moreover, we assume that the macro-economic effects from unconventional gas are unlikely to differ much from other forms of resource extraction. Local and community environmental and social impacts may be quite different, however, to conventional energy extraction.

The paper addresses three inter-linked objectives. The first is to review the literature on regional impacts of energy extraction and distil these into a framework of hierarchical effects that may be useful to policy audiences. The second is to consider how these effects play out differently in the context of conventional compared with unconventional fossil fuel extraction. The third is to draw attention to the institutional avenues for addressing these impacts, synthesising lessons from existing research on the human and policy dimensions associated with conventional energy industries. In doing so, we explore whether the development of unconventional gas may necessitate changes in governance to manage regional social and economic implications and

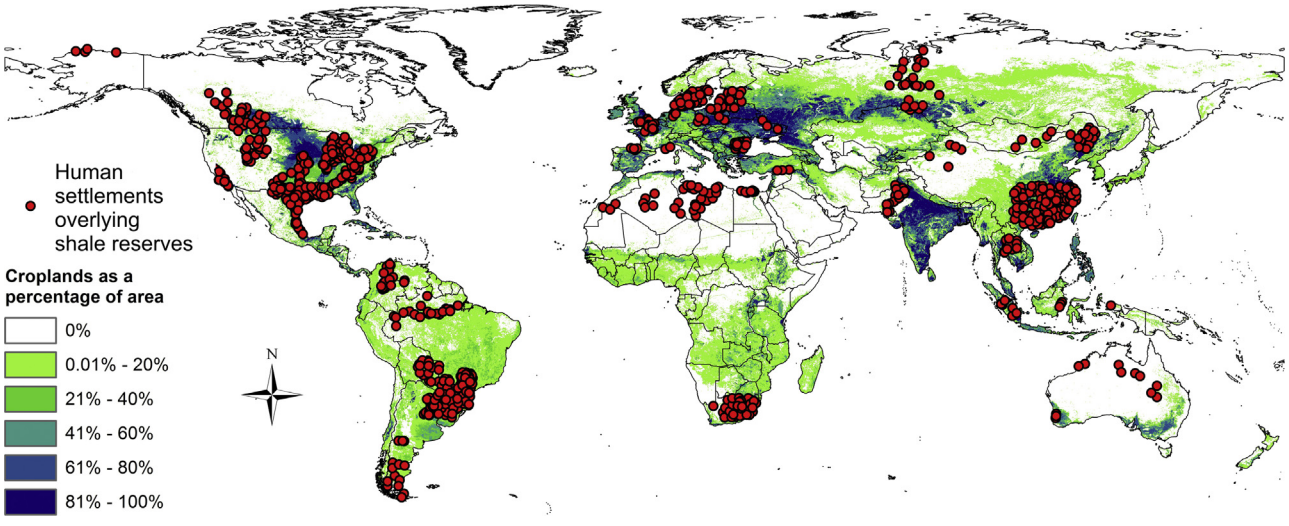

Fig. 1. Human settlements and croplands overlaying assessed shale reservoirs.
Notes: Human settlements overlaying economically assessed shale reserves after Measham and Fleming, 2014b. Croplands defined by Ramankutty and Foley, 1999.