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Social Consequence, Stakeholder Influence, and Resource Needs for Marcellus Shale Communities

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Walden University

College of Social and Behavioral Sciences

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Mary Kathleen Gorman

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Walden University
2014

Abstract

Social Consequence, Stakeholder Influence, and Resource Needs for Marcellus Shale

Communities

by

Mary Kathleen Gorman

MS, University of Richmond, 2009

BS, College of William & Mary in Virginia, 1985

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Policy Analysis and Administration

Walden University

December 2014

Abstract

The process of natural gas recovery by horizontal drilling and hydraulic fracturing, known as fracking, is a major scientific advance in unconventional energy development. Attention has largely been focused on its economic advantages and potential negative environmental repercussions, while less consideration given to its social dimensions. The purpose of this study was to explore the social consequences of fracking for communities in the Appalachian Basin's Marcellus shale. Research questions focused on the role of stakeholders and the resource needs of localities in shaping public policy. This study was guided by the tenets of the Boomtown theory along with key issues in fracking research such as environmental impacts, water resources, public health and safety, economics, and ethical concerns. An embedded case study research design was employed, using a purposive sample of 8 economic and policy subject matter experts from the 3 most prolific drilling counties in Pennsylvania. Data were collected by semi-structured interviews and were analyzed using open and axial coding with cross-case comparison. Results suggested that positive economic social consequences of fracking involved sustainability in providing generational and employment stability. Negative consequences, such as traffic, damaged infrastructure, and housing shortages, were temporary and manageable. Logistical and demographic information were valuable resources for community leadership, and stakeholders favored autonomy in decision making. The implications for social change include informing policy makers how to prepare the local workforce to be adaptable, establish sufficient infrastructure to support change, and educate communities to leverage opportunity in advance of new industry.

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Chapter 1: Introduction to the Study

Introduction

The Marcellus shale underlies eight states from New York to Virginia. As horizontal drilling and hydraulic fracturing techniques used in Texas' Barnett shale are successfully attempted in the Appalachian Basin, unconventional energy development is becoming more common (Theodori, 2009). These new technical developments have facilitated economically viable recovery of natural gas from deep, low-permeability shales like the Marcellus (Weber, 2012). Clean natural gas from unconventional shale formations is expected to account for almost 50% of U.S. domestic onshore production by 2035 (U.S. Energy Information Administration, 2012).

Public discourse has focused on the economic advantages of unconventional energy development, increased energy independence, and perceived negative environmental repercussions. The involved states and the Environmental Protection Agency (EPA) are in varying phases of regulatory development and fact-finding, while localities remain largely without adequate scientific and public policy direction. As a result, incompatible land uses (Blohm, Peichel, Smith, & Kougentakis, 2012), additional demands on public safety and infrastructure (Brasier et al., 2011), inequality among residents, and consistent perceptions of environmental threats appear to conflict with the potential for economic growth (Jacquet, 2012). The ability of localities and states to move beyond perception, toward decision-making based on experience and fact, is the impetus driving this study. This research is intended to advance understanding of how horizontal drilling and hydraulic fracturing has affected Marcellus shale communities,

including how stakeholders and resources influence decision-making and public policy development.

Natural gas recovery from low-permeability shale formations has been made economically and technically feasible by the use of horizontal drilling and hydraulic fracturing. Horizontal drilling involves advancing a vertical borehole, and then trending horizontally through a given geological formation; hydraulic fracturing forces water and chemicals into the borehole using extreme pressure to expose more of the formation to the borehole, thus facilitating larger recovery. Although these techniques have been employed in Texas' Barnett shale for more than 10 years, they are only just beginning to be widely employed in the Appalachian basin's Marcellus shale.

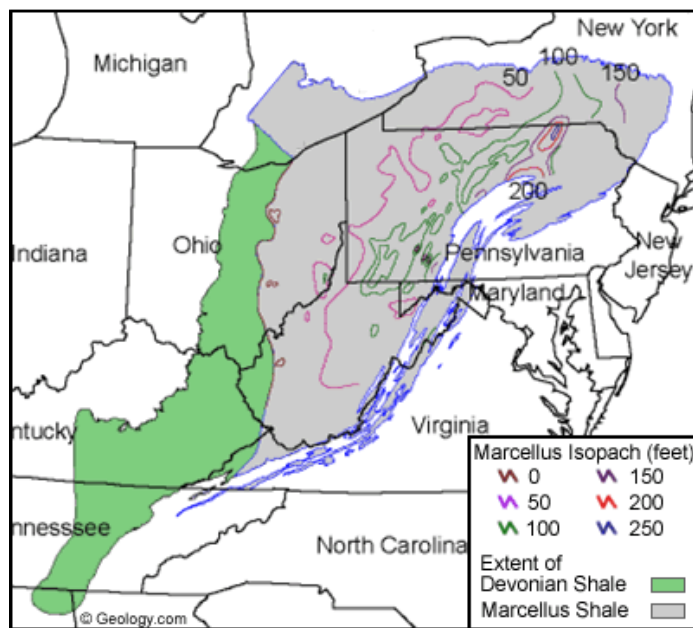


Figure 1. Vertical and Horizontal Extent of Appalachian Basin Shales (Milici & Sweeny, 2006).

As this new phenomenon has become more common, the uncertain short and long-term implications have raised social concerns among the general public and regulators alike. Because the phenomenon is so new in the Marcellus shale, very little is known about the associated social consequences—including how they may be characterized, how they alter communities, and how policy-makers can most successfully manage the effects. Social science research is essential because it can illuminate issues and solutions for those potentially affected in Marcellus shale states and localities. Researchers suggested that how stakeholders have influenced public policy development and the resources needs of localities in decision-making are central to a better understanding the phenomenon.

The phenomenon has multidisciplinary outcomes which span environmental, water resources, political, economic, ethical, public safety, human health, regulatory, and organizational dimensions, among others. These key themes, in particular, should comprise the conceptual framework for this study. Issues and developments within each thematic category have the capacity to influence social perceptions and impact quality of life for communities. A sociological study of multidisciplinary consequences can provide a better understanding of this phenomenon to effect positive social change. The resulting positive social change across disciplinary boundaries can inform public policy and illuminate additional research needs; it can also suggest relationships among the concept areas, and be used comparatively in other geographic areas where the phenomenon may exist.

Armed with a better understanding of the social consequences, stakeholder role and resource needs associated with unconventional energy development, other communities may be able to use that knowledge to maximize and safeguard resources, prioritize social issues, and shepherd public policy. It is reasonable to expect that negative social consequences can be mitigated, and positive outcomes can be leveraged much earlier in the phenomenon's evolutionary process. Because these consequences are likely to include environmental resources and public health and safety, the repercussions can be dire if not adequately managed. The social change implications of this study could save lives, better ensure natural resources are not irreparably damaged, and protect the quality of life in Marcellus shale and other communities.

Chapter 1 is a summary of the background and purpose of this study, including the research questions, nature of the study, conceptual framework, definitions, research method and design, assumptions, scope, delimitations and limitations, and significance of the research within its epistemological context.

Background of the Study

Researchers of unconventional energy development suggested that both positive and negative social consequences have been experienced at the local level. The role stakeholders assume in the development and influence of public policy is central to a fundamental understanding of the phenomenon (Anderson & Theodori, 2009; Jacquet, 2012; McKenzie et al., 2012; Theodori, 2012; Theodori & Jackson-Smith, 2010; Wynveen, 2011). Since 2011, Marcellus shale literature has been largely segregated along disciplinary lines, including geologic, legal, economic, ethics, water resources,

public health and safety, land use and planning, environmental, and alternative energy constructs. Very limited multidisciplinary social science research has been conducted in the Marcellus shale because the phenomenon is only recently becoming widespread.

However, relevant social science research has been ongoing in Texas' Barnett shale since 2008. Within the larger theoretical framework of boomtown theory, recent Barnett shale researchers suggested several concepts that can reasonably be used to create a contemporary conceptual framework for social science research in the Marcellus shale (Anderson & Theodori, 2009; Theodori & Jackson-Smith, 2010; Wynveen, 2011). The extent to which the Barnett shale research findings may directly translate to the Marcellus shale is unclear; it is possible that the different geologic, geographic, cultural, natural resource extraction experiences, and temporal characteristics create social consequences that are decidedly different. As the phenomenon has become more commonplace in the Appalachian basin, social consequences have begun to be recognized at the local level.

Weigle (2010) examined the social perceptions of community resiliency and adaptation, noting various factors influencing social disruption; Liu et al (2012) supplemented social disruption with findings suggesting cohesion within the community as a result of social disorganization. Wynveen (2011) identified social consequence subthemes of justice and equality, quality of life, community identity, health and safety, traffic and road conditions, citizen and stakeholder involvement and power and politics in Barnett shale communities. The gap in the literature I addressed is an exploration of the stakeholder role and an identification and assessment of resources need to manage social consequences. This will lead to a deeper understanding of the experience of local

decision-makers, lending breadth to the phenomenon's social consequences, generally, and incorporating the experience with stakeholders and resources components toward a cohesive exploration of context built upon the literature.

Problem Statement

The research problem in this study was focused on increased unconventional energy development in the Marcellus shale, where technological advances in horizontal drilling and hydraulic fracturing have outpaced public policy. The economic and financial advantages to be gained through widespread energy development are opposed by growing public concern over social issues such as environmental resources protection, land use planning, public health and safety, and ethical principles of distributive justice, among others (Anderson & Theodori, 2009; Robinson, 2012).

Marcellus shale research to date reflects these concerns. Economic aspects were explored by Kinnaman (2011) and Weber (2011), and while both researchers acknowledged positive economic impacts from the phenomenon, how these benefits are distributed and estimated appear to remain largely beyond the scope of existing economic models. Robinson (2012) found that economic ecological economic theory should also take into consideration democratic principles and sustainability, and that social perceptions and consequence management should assume some role in public policy.

The relationship between water resources, energy, and land use in the Marcellus shale was also studied by Scott et al. (2011), Bazilian et al. (2011), and Rahm & Riha, (2011). Their research discovered a disjointed regulatory and public policy framework, despite a demonstrable nexus among systems. A similar lack of consistency between

public health and its role in policy-making was noted by McKenzie et al. (2011), and Goldstein et al. (2012). Whereas public health has emerged as a central concern for Marcellus shale localities, public health professionals were not represented on advisory boards and commissions exploring this issue. Similarly, Finkle and Law (2011) suggested that adverse public health consequences are likely cumulative, and thus unlikely to become evident for decades after chronic exposures are experienced.

Background of the Problem

Brasier et al. (2011), Liu et al. (2012), Weigle (2010), and Jacquet (2012) took a broader, multidisciplinary method in their Marcellus shale research. This social science research incorporated concepts of community resiliency, boomtown effects, social cohesion, population and location characteristics, natural resource recovery experience, and how these factors have influenced social perceptions of unconventional energy development. This research provided the most recent foundation for expanded study of social consequences in the Marcellus shale by identifying some potentially meaningful contributors to social attitudes.

These researchers demonstrated the multifaceted challenges associated with unconventional energy development in the Marcellus shale, and highlighted the importance of additional research across disciplines. Because I focused on the social consequences, stakeholder influences, and resource needs, I addressed a gap in the literature and also informed ethical, legal, economic, environmental, planning, and water resources management aspects of the phenomenon under the larger public policy umbrella.

This research builds upon the aforementioned Marcellus shale research, but as a case study, also has the potential to contribute to the larger epistemology on the phenomenon regardless of geographic location. The case study method was specifically intended to explore the relevance of context as it relates to the larger phenomenon. The Barnett shale social science research completed by Theodori (2009), Anderson and Theodori (2008, 2009), Theodori and Jackson-Smith (2010), and Wynveen (2011) were used to create the conceptual framework for this study; the findings from this research may also be compared to their findings toward a more comprehensive understanding of the social consequences in the Marcellus shale, and in other shale plays.

I addressed a meaningful gap in the current Marcellus shale literature. The gap is described as the social consequences of horizontal drilling and hydraulic fracturing in the Marcellus shale, including the stakeholder role and resources needs of localities in decision-making and public policy development. The social consequences, stakeholder roles, and resource needs that influence the community's experience with the phenomenon may be significant for other communities dealing with unconventional energy development in the Marcellus shale. These communities can mitigate negative consequences and leverage positive benefits if they understand the successes and shortcomings more practiced local decision-makers have already experienced.

Purpose of the Study

The purpose of this embedded case study was to explore the social consequences of horizontal drilling and hydraulic fracturing in the Marcellus shale, including the role stakeholders have assumed in influencing public policy and the resources needs of

localities for decision-making. This understanding of the local context and experience is intended to assist other decision-makers as they grapple with the challenges of mitigating adverse social consequences and leveraging favorable outcomes in their own communities. Augmenting previous case studies in the literature, I also uniquely examined both the stakeholder role and resources needs (human, material, informational) that are integral parts of decision-making processes pursuant to the phenomenon.

The “goodness of fit” of the case study method with the existing literature has informed this research design for consistency and comparative purposes (Anderson & Theodori, 2009; Brasier et al., 2011; EPA, 2011; Liu et al., 2012; Jacquet, 2012; Theodori, 2012; Theodori & Jackson-Smith, 2010; Wynveen, 2011). According to Yin (2013), the case study method is an empirical method of inquiry, with a scope intended to investigate a phenomenon in its unique context; contextual conditions are important in creating new understanding (p. 16). Because the context and the phenomenon are not easily distinguished from each other, the features of a case study should include: multiple variables, multiple sources of evidence, and triangulation of data to “guide data and analysis” (p. 17).

The research purpose was exploratory as I sought a deeper understanding of the phenomenon in its natural setting—the case thus became horizontal drilling and hydraulic fracturing in the Marcellus shale; it also sought to explore processes and relationships which are unclear (context, stakeholders, resources; Yin, 2003). The case was comprised of embedded subunits categorically connected by their specific characteristics and

experience with the phenomenon at the center of the research (three localities within the Marcellus shale).

The research design created the basis for broader investigation in order to ascertain possible cause and effect of context and concepts toward a deeper understanding of the phenomenon. The research questions sought the how and what dimensions of the phenomenon, supporting the exploratory nature of the case study method (Yin, 2003). A holistic case study with embedded units was selected to analyze data within, between, and across the subunits (purposefully-selected individual localities) for a richer understanding of the phenomenon through cross-case synthesis. In addition, according to Stake (1995), the study was instrumental as it was intended to obtain an improved understanding of the larger phenomenon (horizontal drilling and hydraulic fracturing in the Marcellus shale), and collective insofar as it was intended to aggregate evidence to discern similarities and differences among the embedded subunits and with similar cases in the literature. The experiences and unique contexts of the three localities were explored individually (embedded) and collectively (as a case) so I was able to validate which factors of community, context, and experience emerged as significant within, between, and across embedded subunits and within the larger context of the conceptual framework derived from the literature (Stallings, 2002).

A conceptual framework was developed from the qualitative case study research in Texas' Barnett shale (boomtown theory) completed by Theodori (2008, 2009), Anderson and Theodori (2009), Theodori and Jackson-Smith (2010), and Wynveen (2011), and the Marcellus shale case study on social consequences and their influences in

Pennsylvania and New York by Brasier et al. (2011). The concepts comprising the framework included: environmental impacts, water resources concerns, political, economic, and ethical issues, public safety effects, human health worries, stakeholder role(s), regulatory constructs, and decision-making resources and tools for localities. Environmental impacts refer to the concerns communities have with degradation of environmental resources resulting from drilling and hydraulic fracturing (groundwater and surface water contamination, reduced air quality; Liu et al., 2012; Theodori & Jackson-Smith, 2010). Water resources concerns include resource conservation and sustainability (Bazilian et al., 2011; EPA, 2011; Rahm & Riha, 2011; Scott et al., 2011; Weigle, 2010). Political influences are those forces oriented by democratic principles, including justice, equality, community, and ethical decision-making (Hughes, 2012; Robinson, 2012). Economic issues have been defined as increased employment, salary incomes, tax revenue, and social benefits associated with improved public services and local investment (Kinnaman, 2011; Weber, 2011). Human health worries are characterized as both acute exposures and cumulative adverse human health effects (Finkle & Law, 2011; McKenzie et al., 2011). Disparate regulatory constructs are public policy areas which may influence the phenomenon, itself, or impact social consequences (e.g. land use planning; EPA, 2011). Stakeholders include any group which has experienced some degree of disruption from the phenomenon (Weigle, 2010). Decision-making resources and tools will comprise public policy instruments, physical and human resources, and meaningful data needs that the locality deems crucial to managing social consequences.

Research Questions

1. What are the social consequences associated with horizontal drilling and hydraulic fracturing in the Marcellus shale?
2. How have stakeholders influenced public policy development?
3. What resources are needed by localities for decision-making?

Theoretical and Conceptual Frameworks

A contemporary theoretical framework has not been widely accepted for understanding the 21st century social consequences associated with this phenomenon; however, boomtown theory has been informed in the most recent social science literature (Brasier et al., 2011; Wynveen, 2011). Boomtown theory has been applied to extraction of natural resources from the 1970s, when communities in the western United States experienced rapid industrialization as a result of intense development associated with resource extraction (Brasier et al., 2011). This theory suggests that communities experience mixed social consequences with resources extraction longitudinally as the phenomenon evolves (Brasier et al., 2011). With time, communities undergo various phases and attitudes of social disruption—enthusiasm, uncertainty, panic, and adaptation—that shape their perceptions of negative and positive social consequences. Whereas a central boomtown characteristic is rapid population growth, recent studies have suggested that a more contemporary theoretical application of boomtown should necessarily take into account modern social complexities (Wynveen, 2011).

Within the boomtown theoretical construct, I used a conceptual framework that considers a multifaceted, contemporary social fabric. Researchers social science research

in Texas' Barnett shale suggested that relationships among the following concepts: environmental perception variables (Liu et al., 2012; Theodori & Jackson-Smith, 2010), water resources (Bazilian et al., 2011; EPA, 2011; Rahm & Riha, 2011; Scott et al., 2011; Weigle, 2010), political and ethical issues (Hughes, 2012; Robinson, 2012), economics (Kinnaman, 2011; Weber, 2011), public health and safety concerns (Finkle & Law, 2011; Liu et al., 2012; McKenzie et al., 2011), and regulatory constructs (Anderson and Theodori, 2009; Blohm et al., 2012; EPA, 2011; Rahm, 2011; Scott et al., 2011, Theodori, 2008 and 2009; Weigle, 2010). Questions about stakeholder roles and decision-making resources for localities are included in this study so that a strategic approach to managing resources and working with stakeholders might be accomplished in future research; Theodori (2009), Anderson and Theodori (2009), Theodori and Jackson-Smith (2010), and Wynveen (2011) recognized the important role stakeholders assumed in Barnett shale localities. Water resources research by EPA, 2011, Rahm and Riha (2011), Scott et al. (2011) and Bazilian et al. (2011) also suggested that both human and information resources are crucial to effectively managing the nexus among systems. Each of the concepts in the framework related to the phenomenon, as each has been suggested in previous literature as influencing public perception. Inclusion of both the stakeholder and resources concepts are uniquely included in this study's conceptual framework toward assisting other localities manage social consequences.

Nature of the Study

The social constructivist worldview assumes that humans construct their own meaning of the world through individual, subjective interpretation; the context of the

participants is therefore very important (Cresswell, 2009). This meaning is a social process which occurs in a community setting (Cresswell, 2009, p. 8-9). A qualitative method is well-suited for the social constructivist worldview because it is exploratory, inductive, and interpretive. The qualitative method uses an emergent design, open-ended questions, observation, supporting data, and text/image analysis to interpret patterns and themes within and among the data (Cresswell, 2009). Characteristics of qualitative inquiry include: collecting data from participants in their natural setting to establish context, the researcher as the data collection instrument, use of multiple data forms and sources, interpretation of participant meaning, and a full accounting of the complex issue being studied (Cresswell, 2009).

The exploratory nature of the design facilitated an emergence of themes, patterns, variables, contexts, and issues significant to exploring and understanding the phenomenon (Cresswell, 2009). The data analysis process thus became an iterative, inductive procedure to develop a comprehensive list of meaning-making categories, patterns, and themes reflective of participant's meanings and relevant contextual conditions (Cresswell, 2009). Within the qualitative approach, an embedded case study method was selected for this research because it embraced the complexities associated with multiple variables, contexts, experiences, and settings to elucidate similarities and differences with a given phenomenon (Yin, 2003). The unit of analysis is Marcellus shale localities (the case), with three individual localities as embedded subunits; this design facilitated analysis within, between, and across subunits while also promoted a deeper understanding of the larger phenomenon (horizontal drilling and hydraulic fracturing;

Baxter & Jack, 2008). This perspective/worldview-based orientation is made among purposefully-selected communities who share a common experience with the phenomenon (Patton, 2002).

Neither existing theory nor valid quantitative research variables appeared sufficient for these research questions because the phenomenon is, as yet, unformed (Cresswell, 2009). A review of the literature provided justification for the study, supported the selection of the qualitative approach, the embedded case study method, and was a reliable source of data for constructing the conceptual framework (Maxwell, 2005). Key study concepts derived from the literature included: environmental impact, water resources concerns, political, economic, and ethical issues, public safety effects, human health worries, stakeholder(s) roles, regulatory constructs, and decision-making resources and tools. The literature suggested that all of these factors have some influence on perception of positive and negative social consequences for localities.

For this study, the case (unit of analysis) included three embedded subunit counties in Pennsylvania—Bradford County, Susquehanna County, and Washington County. In accordance with case study method, these localities were purposefully selected and represented critical case sampling. Critical case sampling is used to “permit logical generalization and maximum application of information to other cases” (Patton, 2022, p. 243). In addition to critical case sampling, snowball sampling was used to identify key informants with essential information about the phenomenon. These three counties were chosen for several reasons: community experience with the phenomenon, widespread energy development, lack of promulgated state regulations when drilling

began, and consistency with the EPA's 2011 study. These same three counties have been selected by the U.S. EPA (2011) after a national search for their representativeness, transferability of results from common, known impacts, demographic similarities, and because of the water resources component. EPA's sampling rationale suggested an increased ability to regionalize and nationalize (scale) finding from using these three counties as study participants.

The purposeful sampling strategy was used to conduct key informant interviews with local government officials, county managers/commissioners, economic development directors, and planning commission members whose professional duties are directly related to decision-making about this phenomenon in their respective communities. These participants had the principle responsibility for dealing with the local challenges of the phenomenon, including crucial decision-making responsibility, interaction with energy companies, interface with community stakeholders, and reliance on resources (informational, data, human, equipment) to develop public policy and make decisions on behalf of their communities.

Semi structured interview data was supplemented by observation of community infrastructure improvement/degradation to appropriately allow for further analysis of impacts to the community. Local publications were also evaluated for articles pursuant to the phenomenon and used to further contextualize participant responses.

Data were managed using the aid of a computer software package. Data analysis occurred concurrently with data collection and a cross-case synthesis of data was employed. Coding was a phased approach beginning with open coding, followed by axial

coding, culminating with selective coding (Cresswell, 2007). A priori categories comprised of the conceptual framework was initially employed, but through open coding, emergent themes developed. Axial coding was used to test causal relationships, intervening conditions, and similarities among the open coding categories to identify patterns in the data. Selective coding was used to connect the first two sets of coding in support of an explanatory coding paradigm/model. Cross-case synthesis across embedded subunits extended the study to a higher level; findings identified in the patterned data were synthesized to extract a better understanding of the broader unit of analysis, Marcellus shale localities (Yin, 2013). Consistent patterns among the data related to significant issues and emergent factors associated with mitigating negative social consequences and leveraging positive outcomes associated with the phenomenon.

Definitions

Key technical concepts in this study related to unconventional energy development in low-permeability shale formations and the phenomenon of horizontal drilling and hydraulic fracturing. For the purposes of this research, the following definitions applied to the technical concepts:

Unconventional energy development: Unconventional natural gas resources refer to the reserves of natural gas “in coalbeds, shale, and tight sands” (McKenzie et al., 2012, p. 79). For the purposes of this study, unconventional energy development will be more narrowly applied to the low-permeability shale formation of the Marcellus shale where natural gas resources are extracted using horizontal drilling and hydraulic fracturing.

Permeability: The ability of a material to move through a medium. In the case of low-permeability shale formations, natural gas movement through the shale is naturally constricted, requiring artificial means to increase the ability for gas extraction (Lee et al., 2011). By using horizontal drilling and hydraulic fracturing, the inherent permeability of a formation can be markedly increased, allowing for economically efficient resource recovery.

Horizontal drilling: Advancing a vertical well down to a discrete depth, angling the drill bit until it becomes horizontal within the shale, and continuing to advance along the horizontal plane. This drilling technique exposes more of the shale to the drilling process, connecting various fractures, joints, and more surface area in the formation with the well bore (Weigle, 2010).

Hydraulic fracturing: Injection of pressurized water, chemicals, and proppants (e.g. sand) into the borehole forcing open fractures, joints, and bedding planes in the shale to allow natural gas to flow more freely (Finkel, 2011).

Social consequences: The result an activity may have on the social fabric of the community and the quality of life of individuals (Anderson & Theodori, 2010).

Stakeholder: All individuals or groups with a “legitimate interest” in an activity in order that they may “obtain benefits and that there is no priority of one set of interests and benefits over another” (Filipovic, Podrug, & Kristo, 2010, p. 1229).

Resources: Human resources, systems, equipment, and data/information related to the phenomenon that a locality believes are important to consequence management and decision-making.

Assumptions

The ontological and axiological assumptions in this study included acknowledgment that each respondent experience is comprised of a subjective personal viewpoint and a professional viewpoint derived from in his/her role in the community. As a result, it was important to distinguish between personal bias and professional perspective. Participants were asked to clarify any bias that may exist, either personally or professionally. Interview questions involved the decision-making experiences, processes, stakeholder roles, resources needs, and community consequences from the individual's professional perspective. Clarification and interpretation of such bias was considered both during the interview process and with data analysis.

Scope and Delimitations

The specific focus of this study was toward an exploration of the positive and negative social consequences, stakeholder influences, and resources to support decision-making processes for Marcellus shale communities. This focus was selected because it filled a gap in the literature and can be evaluated by employing several analytic strategies. Trustworthiness of findings was accomplished through clarification of bias, triangulation of data (multiple sources), reflexivity, and participant validation of interpretations. Additional evaluative strategies for this study included use of quality descriptive narratives, presentation of discrepant information, and peer review (dissertation committee; Cresswell, 2009). Procedural dependability was achieved by: audiotaping interviews with key informants, maintaining detailed journals and field notes, and applying quality, consistent coding to the data analysis portion of the research.

The boundaries of the study were comprised of the conceptual framework from a thorough literature review, a purposeful sampling strategy consistent with the U.S. EPA (2011) study, and identification of key informants who are uniquely aware and involved in the Marcellus shale decision-making process for their communities. Although the EPA (2011) acknowledges that study findings from this sampling population are not widely generalizable, they are likely to be broadly representative of similar Marcellus shale communities and the challenges these communities are likely to encounter with the phenomenon. The locations EPA selected went through a rigorous national nomination and prioritization process, with decision criteria based upon: magnitude of the phenomenon, proximity and characteristics of population and natural resources infrastructure, health and environmental concerns, diverse stakeholder input, land use considerations, and the knowledge gap that could be filled (p. 59). Although the findings from this study may be unique to Marcellus shale communities, it is reasonable to assume that some findings may be similar to those discovered in Texas' Barnett shale (Anderson & Theodori, 2010), and may be relevant to other geographic settings, as well. Comparative analysis of findings across cases and locations yielded some crucial similarities and differences. In accordance with Lincoln and Guba's (1985) application of transferability, the reader will ultimately determine the appropriateness of transferability of findings.

Limitations

The disadvantage of the case study method is that findings may not be broadly generalizable, because of the comparably limited sampling population and the in-depth

nature of the inquiry. A case study was intended to explore a specific case (or cases) to attain a contextually rich understanding about a phenomenon as opposed to facilitating broad generalizations (Brower, Abolafia, & Carr, 2000, p. 371). The relationships among key variables in the conceptual framework cannot be quantified according to statistical norms. For this phenomenon, the unique characteristics of Marcellus shale communities and the exploratory nature of inquiry supported the selection of a qualitative case study method. It was reasonable to expect that there would be similarities and differences in the experiences of the sample localities (embedded subunits), and it was precisely these similarities and differences that led to a better understanding of social consequences among them and with other cases in the literature.

A quantitative analysis of relationships among key variables was premature at this time. What key variables may be, and what relationships may exist among them was in the formative stage for social consequences of horizontal drilling and hydraulic fracturing for this phenomenon in the Marcellus shale. Formative qualitative research at this point in the phenomenon's evolutionary process may suggest common variables between the Marcellus shale and the Barnett shale that can be used for future quantitative and qualitative unconventional energy development research.

Respondent bias was qualified at the onset of key informant interviews. Trustworthiness of the study hinged on the accurate conveyance of decision-maker experiences and perceptions representative of the unit of analysis (the community)—if these perceptions were unduly influenced by personal bias, then it could undermine the quality of the findings. Researcher bias was also clarified. I have worked professionally

as a geologist in the environmental industry for nearly 30 years. That could have suggested a bias toward environmental activism and resource protection, or conversely, a bias toward responsible drilling and hydraulic fracturing. Reasonable measures were employed to characterize and describe personal and professional bias for the researcher (reflexivity) and respondents, alike.

Significance

The problem statement focused on increased unconventional energy development in the Marcellus shale, where public policy has failed to maintain pace with technological advances in horizontal drilling and hydraulic fracturing (Jacquet, 2012). As a result, perceived economic advantages have been progressively opposed by public concern over social consequences (EPA, 2011). The nature and scope of these social consequences are not well understood, and the importance that stakeholders and resources assume in local decision-making is not well-defined. The findings from this study better characterized social consequences, stakeholder relationships and their influences, and identify resource needs advantageous to public policy development and consequence management.

The implications of this study are relevant for similar Marcellus shale communities as they plan for increased unconventional energy development and prepare to address emerging social consequences. The study findings may be appropriately applied across geographic locations as the phenomenon is experienced in other, low-permeability shale formations across the globe. A better understanding of the phenomenon can assist individuals, businesses, governments, and involved organizations with decision-making and public policy development that mitigates negative

consequences while leveraging positive outcomes. Positive social change has multidisciplinary potential toward environmental justice, adaptability of communities, sustainable practices, economic advantages, effective land use planning, and improved public health and safety, among others.

Summary

The advent of widespread horizontal drilling and hydraulic fracturing in the Marcellus shale has created opportunity, but not without resultant anxiety. A lack of understanding on the part of the general public, combined with a dearth of scientific evidence, has intensified the necessity of technical and social science research about this phenomenon. This study was designed to explore the case of the Marcellus shale locality through cross-case analysis of embedded subunit cases instrumentally and collectively. The research identified what the social consequences are, how stakeholders have influenced decision-making, and what resources a locality needs to develop effective public policy pursuant to horizontal drilling and hydraulic fracturing (the phenomenon) (Stark, 1995).

Chapter 2 is a literature review and substantiation for this study's conceptual framework and the selected qualitative method.

Chapter 2: Literature Review

The research problem follows increased unconventional energy development in the Marcellus shale; while technical and scientific advances have facilitated widespread horizontal drilling and hydraulic fracturing to recover natural gas resources, public policy has not kept pace with technology. This is particularly challenging at the local level, where the effects of this phenomenon are encountered daily. The research purpose was to explore the experiences of localities toward a better understanding of the positive and negative social consequences, resource needs, key stakeholders influences, and other forces that are related to the phenomenon and the importance of context variables.

Social consequences are perceived individually and within the context of a community. Social scientists studying the concept of community acknowledge that, at the local level, people care about issues—the issues which personalize their communities (O'Connor & Gates, 2000). In this study, the phenomenon of drilling and hydraulic fracturing was the issue, and a multifaceted one, at that. It included scientific, economic, legal, ethical, social, public safety, and environmental issues and implications, among others. While each of these facets may influence social perceptions, the literature within tangential disciplines may not necessarily provide data directly relevant to this study; however, the literature which could reasonably inform and contextualize our understanding of the phenomenon was herein included.

A synopsis of the literature revealed that communities in similar shale areas have experienced both positive and negative social consequences, and suggested that these consequences may translate across geologic and geographical settings. A better

understanding of the social consequences experienced by Marcellus shale localities can prepare and guide other Marcellus shale communities as the phenomenon becomes more pervasive. I explored correlations across settings, and identified the unique social consequences and influential forces within Marcellus shale localities, as a case study unit of analysis.

Research Strategies

Literature research was conducted using database searches with certain keywords as search terms, including: *Marcellus shale*, *drilling*, *fracking*, *hydraulic fracturing*, *natural gas*, and *unconventional energy*. Secondary search terms included: *environment*, *safety*, *water*, and *social consequences*. Very few resources were located in the Walden University library databases, so these searches were performed using Embry-Riddle Aeronautical University Hunt Library online databases, including Elsevier, LexisNexis Academic, EBSCOhost Electronic Journals Service, ProQuest Central, PsycINFO, SAGE, Academic Search Premier/Complete, and ScienceDirect. Government websites were periodically examined to determine the status of research by federal and state agencies, including the U.S. Environmental Agency and Department of Energy, and the Commonwealth of Pennsylvania (the locus for the sample population in this study).

Because the Marcellus shale is fundamentally a geological formation, much of the scientific literature from 2008 through 2012 is geological in content, including the shale's structural, geochemical, petrologic, physical, and mineralogical characteristics. In addition, technical literature pursuant to the processes of horizontal drilling and hydraulic fracturing were examined; however, both the geologic and technical literature is less

relevant to this study, which is aimed at exploring social consequences. Social, ethical, economic, public health and public policy research, along with environmental and water resources studies, comprise meaningful sources toward a deeper understanding of Marcellus shale social phenomenon. The social science research, in particular, examines and predicts the evolution of positive and negative consequences, describes how they are prioritized by individuals and communities, and is suggestive of effective public policy tools and strategies. It is the social science literature which is the most germane to this study.

Theoretical Framework Defined

The theoretical framework for this study is the boomtown theory which posits that social consequences occur in stages with associated attitudes including: enthusiasm, uncertainty, panic, and adaptation to the phenomenon of extraction of natural resources (Brasier et al., 2011). As a result, community and decision-maker attitudes evolve and adapt longitudinally. In contrast to previous boomtown literature, Brasier et al. (2011) discovered that the Marcellus shale phenomenon uniquely incorporates population, proximity, infrastructure development with traditional boomtown concepts of level of development and extractive history (p. 55). Wynveen, (2011) expounded on the boomtown theory to identify specific conceptual variables associated with horizontal drilling and hydraulic fracturing in Texas' Barnett shale. The positive and negative social consequences included economic, social, and environmental concepts, and recommended that future research span geologic formations, geographic boundaries, and community characteristics (Wynveen, 2011).

Conceptual Framework Defined

Within the theoretical framework of boomtown theory, contemporary social science research on unconventional energy development has focused on the positive and negative social consequences associated with horizontal drilling and hydraulic fracturing. Social science research in the Barnett shale has been ongoing since 2008, with similar research initiated in the Marcellus shale beginning in 2011. Key research findings from the literature comprise the conceptual framework for this study. The conceptual framework included exploration of the following concepts and their relationships: environmental impacts, water resources concerns, political, economic, and ethical issues, public safety effects, human health worries, stakeholder(s) roles, regulatory constructs, and decision-making resources and tools for localities. Because the research method is qualitative, other concepts may emerge as significant during the course of this study.

For the conceptual framework, a definition of each concept originated from the literature, and will be summarized in the following paragraphs. Environmental perception variables are common in nearly all social science literature associated with the phenomenon, and have been characterized by Theodori and Jackson-Smith, (2010) and Liu et al. (2012) as the concerns communities have with environmental degradation resulting from drilling and hydraulic fracturing processes (groundwater and surface water contamination, reduced air quality). Water resources concerns are related to environmental perception, but also include resource conservation and sustainability. The EPA's (2011) study, Rahm and Riha (2011), Scott et al. (2011), Bazilian et al. (2011), and Weigle, (2010) highlight the interdependence of social systems with water resources

management, both in terms of water quality and quantity. Thus, environmental and water resources concepts will encompass both quality and quantity indicators.

Political influence guides public policy and decision-making at the local level and has been related to positive economic and social benefits derived from the phenomenon, as well as ethical considerations. This study defined political influences as those forces oriented by democratic principles, including justice, citizenship, equality, community, and ethical decision-making (Robinson, 2012). Ethical considerations also include the four mechanisms of injustice as defined by Hughes (2012), including: political economy of poverty, thick injustice, technocratic governance, and institutional capacities.

Economic benefits are defined as increased employment, salary incomes, tax revenue, as well as the social benefits economic advantages facilitate, including improved public services and investment at the local level consistent with the research completed by Weber (2011) and Kinnaman (2011).

Public health worries are characterized as both acute exposures (McKenzie et al., 2011) and cumulative adverse health effects related to the phenomenon in all media (air, water, soil) (Finkle & Law, 2011). These concerns have been identified in the literature and in public discourse, although very little actual data have been collected in this regard; it is reasonable to expect that public health worries have some influence on social perceptions.

Disparate regulatory constructs were found to be significant in the social science research (Anderson & Theodori, 2009; Blohm et al., 2012; Brasier et al., 2011; EPA 2011; Rahm, 2011; Scott et al., 2011; Theodori, 2008 and 2009, Theodori & Jackson-

Smith, 2010; Wynveen, 2011; Weigle, 2010). For the purposes of this research, regulatory constructs were defined as public policy areas which may influence the phenomenon, itself, or which may impact social consequences, including but not limited to: environmental, land use and planning, public safety, environmental, and social policies at any level of government.

The specific inclusion of both the stakeholder(s) role and decision-making resources/tools in this study were purposefully intended to augment the existing literature toward a helping other localities strategically manage social consequences. Anderson and Theodori (2009), Theodori (2009), Theodori and Jackson-Smith (2010), and Wynveen (2011) noted the importance for future research to explore the influence stakeholders may have on the phenomenon; Weigle (2010) found that competing interests and priorities among community members contributed to social disruption. Thus, the definition of stakeholder in this study included any group which has experienced some degree of disruption from the phenomenon and that has a compelling interest in the phenomenon, as described by Weigle (2010).

Finally, decision-making resources and tools comprised public policy instruments, physical and human resources, and meaningful data needs which the locality, either moving forward or in retrospect, deemed critical to decision-making and consequence management. Policy instruments included land use policies, zoning restrictions, and local ordinances; data and resources included geographic information systems, economic, environmental, and demographic data, and equipment, human, and financial resources.

Initially, a review of research strategies was provided to clarify the relationships among the inter-disciplinary literature and to assist future researchers. This was followed by an accounting of the seminal social science research used to construct the conceptual framework of this study, and finally, other literature was summarized which can add dimension to data analysis and interpretation. The literature encompasses research from 2008 through November, 2014.

Seminal Social Science Literature

Seminal work on social consequences associated with horizontal drilling and hydraulic fracturing has been completed by Anderson and Theodori (2009), Theodori (2008, 2009), Theodori and Jackson-Smith (2010), Wynveen (2011), and Brasier et al. (2011). The work by Anderson, Theodori, Jackson-Smith, and Wynveen was set in Texas' Barnett shale. Although the setting is different from the Marcellus shale, their collective findings helped create a conceptual framework for this study because it is the most in-depth social research on the drilling and hydraulic fracturing phenomenon.

Anderson and Theodori's (2009) work in the Barnett shale was a comparison of two localities—one which had been drilling and hydraulic fracturing for more than a decade, and one where the phenomenon was just beginning. The researchers found that while similar consequences between the localities were noted, the weighted effects were perceived differently. Economic prosperity was positively associated with the phenomenon, and improvements in public services (education and medical, in particular) were noted. As regards negative consequences, the data were categorized according to public health and safety concerns, environmental degradation, and quality of life issues.

The researchers discerned that significant perceptions over the weighted benefits were directly correlated with the site maturity of the phenomenon (length of time; p. 117). This suggests that immediate economic benefits are heavily favored in the locality where the phenomenon was new, as compared to overwhelmingly negative perceptions in the locality where the phenomenon was experienced for more than 10 years. Anderson and Theodori recommended that this finding be explored further; they also recommended that different stakeholder perspectives be explored and compared, and that disparities among wealth and power in local communities be examined. Anderson and Theodori proposed potential indicators of social disruption related to unconventional energy development; whether or not these indicators translate across geographic boundaries to the Marcellus shale is something this study will inform.

Anderson and Theodori's (2009) publication is one of several social science studies in Texas' Barnett shale. In 2009, Theodori used random sampling of residents in the same two localities to assess perceptions of problems associated with natural gas development (as opposed to actual consequences). The paradoxical results suggested that the general public disliked the social and environmental problems accompanying the phenomenon, but had favorable attitudes about the economic and public service-related benefits this same development brought to their communities. In the locale where unconventional energy development had been going on longer, residents had more positive attitudes toward economic and service-related benefits (including poverty, quality of local schools, fire protection, health and medical care, and the availability of good employment). Theodori concluded that negative perceptions of the phenomenon

could be somewhat mitigated by dispelling misperceptions, creating partnerships with stakeholders, clear communication, and public education.

Theodori (2012) built upon his 2009 work by introducing research variables of mineral rights, personal ties to the industry, and residency tenure in the locality.

Theodori suggested a strong correlation between positive public perceptions and residents with mineral rights ownership, whereas personal ties and tenure had little statistical significance. Resident support for more environmentally friendly drilling practices, natural gas companies going beyond minimal legal/regulatory requirements, and better information sharing were among the most prevalent resident perceptions of the industry.

Wynveen (2011) used Theodori's (2012) previous survey results in a qualitative analysis of emergent themes. She discovered three common thematic groupings: economic, social, and environmental. With regard to social consequences, emergent subthemes included: justice and equity, quality of life and community identity, health and safety, traffic and road conditions, and citizen and stakeholder involvement, and power and politics (p. 16). Wynveen cited implications for stakeholders, which she characterized as being comprised of community leaders, industry operators, and residents. Community leaders must recognize and mitigate economic disparities and serve as a liaison between industry and the general public; industry must proactively prevent adverse impacts and engage the citizenry in ongoing dialogue; and residents should assume a more active position in seeking information and communicating their concerns to both government and industry. Wynveen recommended that future social consequence research be focused on identifying common themes in other shale settings

and how the unique characteristics of these settings/localities might influence social consequences. This present study is intended to inform those questions within the Marcellus shale setting, using a similar case study research design.

Theodori's (2010) work with Jackson-Smith assessed an adjacent county in Texas' Barnett shale. In comparison with previous studies of residents' perceptions of natural gas development, Theodori and Jackson-Smith found that social and environmental perception variables were a key factor in formation of resident attitudes. This central finding is significant because it highlights the need for better communication among government regulatory agencies and energy companies with key stakeholders; the stakeholder role in shaping public perceptions and attitudes is something this research intends to expound upon.

Resident perceptions of community and environmental impacts within the Marcellus shale have been researched by Brasier et al. (2011). Brasier et al. employed longitudinal and comparative approaches to study the boomtown effects associated with extraction of natural resources. Previous researchers on the boomtown mentality identified four stages of changing attitudes among boomtown residents: enthusiasm, uncertainty, panic, and adaptation, within the boom-bust-recovery cycle associated with this process (Jacquet, 2009). Brasier et al. noted mixed social impacts associated with early boomtown models, including decreased social cohesion and community disorganization; inequities were also observed associated with demographic characteristics (e.g. age, gender, social class). These findings support the social disruption model (Markussen, 1978, Merrifield, 1984, Park and Stokowski, 2009). Later research

(Anderson & Theodori, 2009, 2011; Gramling & Brabant, 1986) challenged some of the characteristics advanced by the social disruption model; these may be attributed an increasingly urbanized setting and/or the ability of a locality to absorb population increases and adapt to change. In this study, Brasier et al. examined four cases in Pennsylvania and New York with contrasting experience in both natural gas extraction and levels of activity (from high to low). The results identified key factors which contributed to differing perceptions among localities, including: population size, closeness to transportation networks and major population centers, level of infrastructure development, and extractive history. Recommendations included future studies to document both perceived and actual social consequences with consideration given to the causes influencing these perceptions.

The difference in perceptions which may be related to extraction history was studied further by Liu et al. (2012) for 943 communities in Pennsylvania which had a least one abandoned coal mine. The intent was to ascertain if a correlation existed between coal mine experience and socioeconomic deprivation, social disorganization, and physical disorder (three measures of community linked to adverse health outcomes) (p. 2). They noted that “healthy communities” are positively related to social functioning and material/institutional resources (p. 7). These researchers discovered that social disorganization, characterized by the inability of a community to establish and maintain effective social controls and realize common value among its residents, is negatively associated with environmental degradation. This rather surprising finding suggests that adverse conditions may, in fact, create larger cohesion among members; it is also

possible, however, this finding could be a result of economic inability of members to relocate. The research may have relevance for Marcellus shale localities, to ascertain what relationship may exist between the degree of social disorganization, a community's perceptions of its health, and the extent of the phenomenon.

The opposite of social disruption is a community's ability to adapt to change. Weigle (2010) studied the social perceptions of individual and community resiliency and adaptation in a 12 county region of Pennsylvania where unconventional energy development is occurring in the Marcellus shale. Weigle identified four main categories related to public perceptions in the Marcellus shale, including: socioeconomic, environmental, government and planning, and health and safety concerns (p. 9). The key findings which emerged from Weigle's research related to access to information, personal investment, political views, experience and involvement with the phenomenon. Weigle found that all study participants experienced some degree of disruption from the phenomenon, followed by change, and ongoing adaptation (personally and as a community). Weigle noted that disruption was personalized, creating competing interests and priorities among community members, thus undermining resiliency potential. But, when perceptions of responsibility were juxtaposed on these concerns, meaningful adaptation within communities and across government levels and agencies was facilitated. Weigle concluded that financial compensation, experience, and environmental attitudes all, in some way, influence residents' attitudes toward natural gas extraction; this further suggests that opposition toward the phenomenon might be overcome by providing compensation to individuals not directly involved in drilling (e.g. in the form

of royalties to localities, school districts, etc.). These study variables of proximity, financial compensation, experience, and environmental attitudes are forces which may provide additional context for data interpretation in this study. Weigle recommends that ongoing research focus on resiliency and adaptability in Marcellus shale localities so that we can better understand the forces of change associated with the phenomenon.

Unconventional energy development related to natural gas extraction can reasonably be compared to other alternative energy options. Solar and wind power offer additional research constructs. In a comparative study of resident attitudes toward natural gas versus wind energy development in Pennsylvania, Jacquet (2012) examined relationships among the following variables: geographic proximity, economic influence, and environmental attitudes. Jacquet found negative attitudes related to intensive natural gas development, and generally positive attitudes associated with wind farm development. He also found that landowner attitudes were more strongly associated with one's personal experience with an energy company than one's proximity to the phenomenon. This research can be informed by Jacquet's findings.

Although there is no emergent theoretical framework in the literature for this contemporary phenomenon, the most recent social science literature related to unconventional energy development has informed boomtown theory. As a result, this research design employed a contemporary application of boomtown theory using a more detailed conceptual framework. Some of the existing environmental, economic or hybrid (ecological economics) theories may prove to be relevant, but have not been thoroughly explored during this study and are largely discipline-specific. Systems, stakeholder,

stewardship, economic and risk-related theories are a few examples of theoretical frameworks which should be considered for future research.

Recent publications have explored social perceptions of risk, residents' attitudes of the phenomenon, and public policy development. Brasier et al. (2013) measured risk perceptions associated with development and attitudes related to trust in various institutions, agencies, and environmental groups responsible for managing risk, along with demographic and geographic characteristics of respondents, education, length of residency in county, and mineral rights variables, among others. The researchers suggest that individual risk assessment is a highly complex endeavor and that apprehension about whether or not the energy industry will operate safely competes with economic opportunity and fear about adverse environmental impacts, among other factors (p. 14). They noted that in the early boomtown stage, problems and perceived unethical practices by the energy companies associated with leases contributed to undermining trust in the community; but that "participatory processes" and "constructive dialogue" can build trust with time among interested parties (p.15-16). This research confirms findings in Brasier et al. (2013), and supports these recommendations for participatory dialogue, particularly in the early stages of the phenomenon.

Schafft, Borlu, and Glenna (2013) studied the relationship between local perceptions of risk and opportunity through the lens of school districts in Pennsylvania's Marcellus shale region. They confirmed a strong positive association between risk and opportunity, but noted that school administrator views are that there are both negative and positive perceptions of challenges and opportunities (p. 160). Regarding boomtown

theory, they recommend that drilling extent is their most important scholarly contribution to the theory—variability with time, intra-regionally (with local development), and therefore with differential community effects.

Another recent publication related to resident views was a longitudinal study (2009-2012) in Pennsylvania completed by Willits, Luloff and Theodori (2013). The most significant finding from their study was that more respondents appeared to have enough knowledge gained during that short period of time to answer the survey questions than they had during the previous survey. Additionally, in both the 2009 and 2012 surveys, support for drilling was larger than opposition. 2012 respondents indicated larger opposition to drilling, however, and respondents in 2012 were more concerned about environmental issues than were the 2009 respondents.

Heuer and Lee (2014) examined stakeholder attitudes in the Susquehanna River basin in Pennsylvania across stakeholder sectors, nonprofit, government, and private on four categories, economic opportunity, health and safety, preserving communities, and achieving energy security (p.1). The researchers found that public concern ranked, in order: health and safety, communities, economic opportunity, and energy security (p. 15).

Public Health

Whereas proximity does not necessarily correlate directly with resident attitudes toward the phenomenon, proximity has been tied to public health risk. A study conducted by McKenzie et al. (2011) evaluated health risks associated with exposures to air emissions from a drilling and hydraulic fracturing site in Colorado. Samples were collected from fixed monitoring positions during various phases of the process (total 163

samples). The analytical results suggest that there is a larger risk for residents living within a half-mile radius of this drilling site than for those outside of that area. The largest concentrations were measured over the short-term period when well completion was performed. In addition, chronic exposure risk was found to be larger for residents within the half-mile radius over the long-term. The research recommended additional studies on the short and long-term public health effects of the phenomenon, the influence of meteorological conditions and topography on risk, and potential medical surveillance for those working at sites and residing/working nearby.

Although the results of the McKenzie et al. (2012) study suggested a statistically significant relationship between proximity to the well site and increased health risk, comparably little work has been conducted on the hazards associated with air emissions from drilling and hydraulic fracturing operations. In fact, public health professionals have been largely absent from the public discourse. Goldstein et al. (2012) reported that public health professionals were not represented on any of the prominent Marcellus shale advisory boards, including the Pennsylvania Governor's Marcellus Shale Advisory Commission, the Maryland Marcellus Shale Safe Drilling Initiative Advisory Commission, or the Secretary of Energy Advisory Board (SEAB) Natural Gas Subcommittee. The article noted that the impetus behind the formation of these advisory boards and committees was the overwhelming public concern about adverse environmental and health impacts, which public health professionals are in a unique position to contribute to. Social consequences associated with public health perceptions and stakeholder involvement are part of this research design.

To date, public health data has not been comprehensively assembled or analyzed; Finkle and Law (2011), in the American Journal of Public Health, enumerated some of the more serious health hazards posed by the phenomenon. The research focus was on the chemical compounds associated with hydraulic fracturing, and the cumulative adverse health effects which may not become evident for decades after initial/chronic exposures, including trans-generational transference. The authors advocated a “precautionary principle” for regulators until actual health effects can be adequately assessed. Additional public health research can help to quantify the risks posed by the phenomenon, in all media (air, water, soil). In the absence of comprehensive public health data, it is unclear how relatively ambiguous public health concerns actually influence social perceptions.

Water Resources

As unconventional energy development became more widespread, public concerns about health, safety, and environmental quality increased. As a result, in 2009, Congress tasked the EPA with conducting a study intended to determine what correlation may exist, if any, between hydraulic fracturing processes and adverse impacts to drinking water supplies in the Marcellus shale (EPA, 2011). According to EPA (2011, p. 1), the study’s goal was to develop answers to two fundamental questions:

1. Can hydraulic fracturing impact drinking water resources?
2. If so, what conditions are associated with these potential impacts?

The process by which EPA undertook this research included extensive stakeholder input, consultation with government and private partners, and guidance from its Science

Advisory Board (SBA) in a phased approach. The final report is estimated to be released by the agency in 2014.

The findings of EPA's study are likely to significantly influence public perceptions of the positive and negative social consequences associated with drilling and hydraulic fracturing. The conclusions may also change the public policy landscape at all levels of government.

Horizontal drilling and hydraulic fracturing processes have a direct relationship with water resources management in five specific areas: water withdrawal, chemical mixing, injection, flowback and process water management, and wastewater treatment/disposal (U.S. EPA, 2011, p. ix). EPA's study is intended to explore these relationships, but other literature also contributes to the existing knowledge of these issues to some extent.

Drilling and hydraulic fracturing can influence water resources both above and below ground; in addition, some events are certain to occur (necessary for production), and others are considered probabilistic (unplanned discharges, spills). Rahm and Riha (2011) applied public policy alternatives to water withdrawal and wastewater treatment scenarios in the Susquehanna River Basin of New York state. They acknowledged that drilling and hydraulic fracturing projects occur at different times and across regional areas, but that these projects have a collective impact. They recommend an approach which combines regional water resources planning and development with project-level environmental oversight. They support this study's strategic management approach for minimizing adverse environmental consequences and realizing economic development

benefits. The researchers proposed a combination of regional water resources management and project-focused environmental protection regulation.

The relationship between energy development and water resources public policy has also been characterized as a “water-energy nexus” by Scott, et al. (2011). They used case studies to illustrate the interdependencies between these two systems, while determining a fundamental lack of “tandem management of both resources” (p. 6622). They suggested that energy and water relationships are managed on an input-output basis without regard for the institutional scale of control; further, decision-making authority does not correlate with consequence management when energy and water resources management are not coupled. They proposed a new paradigm which employs a water-energy nexus. This nexus redefines institutional decision-making and public policy development through a linking of social and environmental impacts experienced at the state/local levels with decision-making on national and global scales. The authors’ recommendations suggest that the nexus should be explored further within a social framework to determine how physical and social factors may influence an expanded demand for resources (p. 6630). The extent to which Marcellus shale localities manage resources independently and/or in tandem is something this study will identify.

Scott’s (2011) water-energy nexus research findings were corroborated by work performed by Bazailian et al. (2011). They expanded the water-energy nexus by incorporating a third variable, food. They discovered that single sector public policy approaches fail to improve resource allocation and economic efficiencies, while also failing to minimize adverse impacts associated with the environment, human health, and

economic development (p. 7906). They recommend that social consequences are better managed in the long term by using a holistic accounting across existing regulatory constructs using tools which integrate resource planning.

The disjointed regulatory framework resource planning traverses is clearly evident in Texas. Rahm (2011) used Texas as a harbinger of the future in her study of the evolution of unconventional energy development in the U.S. and worldwide. The absence of a “cohesive” regulatory policy at the federal level has had a domino-effect for states legislatures, regulatory agencies, and local governments (p. 2978). Fragmented regulatory authorities in Texas were specifically associated with environmental, mineral rights, water (quality and supply), air quality and emissions, pipeline eminent domain, and land development planning. These incompatible areas of control have resulted in social and political conflict which supports the type of holistic resources planning and management strategies proposed by other researchers. Without comprehensive directives from the federal level, Rahm suggested that the culture of Texas will be the primary impetus controlling the future of unconventional energy development. How a state, region, or local culture may influence the phenomenon is something this research seeks to inform.

Disjointed public policy was specifically explored for the Marcellus shale in a study by Blohm et al. (2012). The authors used a geographic information system to identify land use patterns and their corresponding public policies on drilling and hydraulic fracturing to create an accessibility map; this map was used to adjust existing shale gas resource potentials based on spatial distribution. By combining current land use availability/patterns with public policy and regulatory structures, the authors concluded

that recoverable gas estimates have been overestimated by nearly double (p. 366). While their research had limitations, including mineral rights, homogenous distribution of gas within the formation, open areas equated with drilling potential, and well-specific characteristics (e.g. length), its value to this study is related to public policy variations based on geopolitical and land use choices, a reflection of social perceptions and decision-making at the local level.

Economics

The economic benefits associated with horizontal drilling and hydraulic fracturing has been widely reported, and summarized by Kinnaman (2011). Kinnaman assessed published studies from 2000-2010, and included analyses in Pennsylvania, New York, Arkansas, Louisiana, and Texas. Conclusions about positive economic impacts were found to be largely overstated, failing to account for such factors of geographic variability of where financial gains are both spent and received, and price differences associated with time. Kinnaman concluded that there are significant flaws in the existing econometric models for determining the economic impact of the phenomena, and that these inaccuracies are likely to mislead homeowners, businesses, and government in crucial decision-making processes.

A comparative study conducted by Weber (2011) assessed economic impacts from resource extraction booms at the local level in 338 counties in Texas, Wyoming, and Colorado. Weber suggested that the counties where resource extraction was focused did experience increased employment and salary incomes, while adjacent counties saw weaker growth. Weber recognized that economic gains at the local level were affected by

the transitory nature of workers; thus it is difficult to ascribe these gains to a particular locale. State tax revenue generated by the phenomenon was positively associated with lower taxes for localities and an increase in public services and investment (p. 1587). Like Kinnaman (2011), Weber discovered that estimates are widely overstated using input-output economic models, but that economic benefits can be a positive consequence of the phenomenon at the local level. Weber acknowledged that economics positively influence the pro-drilling political rhetoric associated with the phenomena, but that economic estimates were only one indicator to consider; true costs and benefits are more comprehensive, and should factor-in environmental, health, infrastructure degradation, and water resources quality and management in the overall analysis.

Weber's (2011) findings about the multidisciplinary nature of the phenomenon may suggest an ecological economic framework for analysis. By definition, ecological economics integrates human and ecological disciplines, thereby creating a trans disciplinary epistemology. In this epistemology, the economic facet of social organization is studied according to physical and social influences (Luzadis et al., 2010). Luzadis et al. studied the content of ecological economic literature from 1989 to 2004, and found that although economic issues were better represented than ecological ones, a move toward pluralism and trans disciplinarity in the field was recognizable. The authors recommended that ecological economics, as a discipline, should strive for content which is more balanced—to include more physical and social science foci that influence public policy. Ecological economics may represent a reasonable theoretical framework for the

study of this phenomenon; the results of this study should suggest its possible relevance for further research.

Ethics

In his study of ecological economics, Robinson (n.d.) explored the epistemology using the lens of political theory. Assuming that ecological economics may represent a suitable framework for exploring unconventional energy development, the use of political theory might be important to public policy development in this regard. Robinson found that ecological economics fails to adequately incorporate some of the most fundamental democratic concepts, including justice, citizenship, community, populism, and equality, among others. The study questioned the congruence of unfettered economic growth and competition with sustainability, and employed democratic principles such as restorative justice as a means of ascribing responsibility to the populace for the decisions it makes. Robinson concluded that economic gains and unsustainable human practices affixed to ecological economics rely too heavily on new technologies to fix the problems of today and the potential problems of future generations. Instead, the political concept of justice should orient ecological economic theory so that consequence awareness and management is equally considered in today's decision-making processes. This approach connects sustainability with democratic principles, and is relevant to this phenomenon as it relates to social perceptions of consequence and public policy development.

The concept of justice as it relates to planning, resource management, and public policy has also been explored by Hughes (2012) within the context of climate governance. The fundamental mechanisms which promote injustice in climate

governance may also have particular relevance in unconventional energy development. Hughes identified four mechanisms of injustice, including: political economy of poverty, thick injustice, technocratic governance, and institutional capacities (p. 3-4). Political economy of poverty describes the injustice in planning which excludes the economically-disadvantaged from political decision-making processes; thick injustice refers to deep-rooted historical policy disparities and spatial inequities which perpetuate economic and political injustice. Technocratic governance, particularly prevalent in environmental policy-making, reflects an over-reliance on scientific and technical processes which are not well understood by disadvantaged groups, and fails to incorporate input and perspectives of these groups. Finally, institutional capacity refers to the very real limitations of local governments, administratively, financially, technically, or operationally, to meet the needs of disadvantaged persons in the community. Hughes' work connected ecological economic concepts with ethics and democratic principles, and provided tangible mechanisms of injustice which may enhance understanding of the positive and negative social consequences associated with this phenomenon.

Summary

The literature related to this phenomenon suggested that research in Texas' Barnett shale may reasonably inform social consequence experienced and community perceptions in the Marcellus shale. The literature identified key themes from previous case study research, including: environmental impacts, water resources concerns, political, economic, and ethical issues, public health worries, stakeholder roles, regulatory constructs, and decision-making resources and tools. These themes comprised

the conceptual framework for this study. This study will advance knowledge of the phenomenon across disciplinary divides, and suggest public policy approaches and tools for communities to mitigate negative social consequences while leveraging positive outcomes associated with the phenomenon.

To date, the literature suggested that communities have experienced both negative and positive social consequences associated with the phenomenon; however, the actual social consequences experienced by Marcellus shale localities are only just beginning to be realized as the phenomenon becomes more widespread. This case study explored the (embedded) case of three purposefully-selected localities most representative of Marcellus shale communities. By exploring the experience of these localities, a deeper understanding of the community experience and the phenomenon, itself, became possible. This study also included the role of stakeholders and decision-making resources and tools which were previously suggested as significant for future research in the literature.

Chapter 3: Research Method

Introduction

The purpose of this study was to explore the social consequences of horizontal drilling and hydraulic fracturing, stakeholder influence, and resource needs of Marcellus shale localities (the case). The case was comprised of three purposefully-selected localities as embedded subunits of analysis. The exploratory research design was applied when there is no clear set out outcomes between phenomenon and context (Yin, 2013); in addition, this research was both instrumental and collective to gain a better understanding of the general phenomenon and to aggregate evidence for interpreting similarities and differences across subunits and with the conceptual framework derived from the literature (Stake, 1995). Analytic generalization was possible to unravel the complex forces and contexts central to the phenomenon, and to perform comparative analysis among embedded subunits and across cases externally (Yin, 2013). According to Yin (2013), there are 5 components of the case study research design: unit(s) of analysis, study questions, propositions, logic linking propositions to the data, and the criteria for interpreting research findings (p. 29). Propositions are not necessary for an exploratory case study, so the research questions and the conceptual framework were used guide the study. Each of the other components is included in this chapter.

Setting

The first component of case study research is the definition of the unit of analysis, or the case (Yin, 2013). For this study, the case was defined as communities in the Marcellus shale which have experienced widespread horizontal drilling and hydraulic

fracturing. The embedded subunits of analysis comprised three purposefully-selected localities, a critical case sampling strategy consistent with the EPA's (2011) water resources study. As an embedded case study, this research will "yield the most information and have the greatest impact on the development of knowledge" (Patton, 2002, p. 236).

The setting for this study comprised three Marcellus shale localities purposefully selected for their experience with the phenomenon, their widespread energy development, the lack of promulgated regulations during the initial phases of drilling and hydraulic fracturing, and the water resources element (Bradford, Susquehanna, and Washington Counties). These localities were consistent with the ongoing study by the EPA (2011), and were specifically chosen after a national evaluation for the increased ability to regionalize and nationalize findings from these particular participants (EPA 2011).

Key informants from each locality were selected for their experience with the phenomenon; these individuals were local government officials, county managers/commissioners, economic development directors, and planning commission members whose professional duties were directly related to decision-making pursuant to the phenomenon. Their involvement in the decision-making process for the phenomenon in these localities provided a critical case sampling perspective for this exploratory study. To date, unconventional energy development research has been comprised of case studies; thus, this research design was consistent with the existing literature and could facilitate comparison within, between, and across the embedded subunits herein, and with other case studies in the literature.

Research Design and Rationale

The research questions are the second case study component, according to Yin (2013).

1. What are the social consequences associated with horizontal drilling and hydraulic fracturing in the Marcellus shale?
2. How have stakeholders influenced public policy development?
3. What resources are needed by localities for decision-making?

For this exploratory study, the case study method was selected to answer the research questions because it facilitated an emergence of themes, variables, and issues that were significant to the experience and context of the purposefully-selected localities (Cresswell, 2009). According to Yin (2003), a case study is an appropriate method when the contextual conditions are believed to be relevant to the phenomenon; but the boundaries are unclear between the phenomenon and the context (Baxter & Jack, 2008, p. 545). This collective case study explored nuances of the various factors and contexts that had a bearing on the local experience with the phenomenon. The interpretive aspect of data analysis allowed the dynamic, contextual aspects of the focused setting, problem, and participant group to emerge as significant. The reader may then decide whether or not the findings may be transferable given the unique characteristics of the case and embedded subunits individually and collectively. Consistent with boomtown theory, perceptions will also be influenced longitudinally as phases of resource extraction evolve (Brasier et al., 2011). These nuances were noted as part of data analysis.

Data collection for this qualitative research employed semi structured interviews of key informants within their natural setting, the researcher as the data collection instrument, categorization of data, interpretation of participant meaning, and a full accounting of the phenomenon being studied (Cresswell, 2009). Data collection included the use of multiple sources of data toward a holistic convergence of sources to elucidate a larger understanding of the phenomenon; multiple sources also supported study rigor (Baxter & Jack, 2008). As with most qualitative research, data collection and analysis occurred concurrently. Data analysis transcended description, and instead sought to interpret how stakeholder roles and resources needs have influenced public policy decisions. These experiences of the study case and subunits can thus were contextualized, characterized interpretively by the researcher, compared within, between, and across embedded subunits toward a richer understanding of the broader phenomenon. This cross-case synthesis also increased research validity.

Role of the Researcher

The role of the researcher in this study was as data collection and analysis instrument. Toward bias, I do not live in the area, has no friends or family involved in the phenomenon, has no relationship with the participants, and did not benefit financially or otherwise from the study. I have worked professionally as a geologist in the environmental industry (public and private sectors) for approximately 25 years, but have no firsthand experience with the phenomenon or strong personal opinions regarding the research questions. I have also been involved in development of state regulatory policy, but not as it pertains to this phenomenon. While I recognize there are both positive and

negative consequences associated with the phenomenon, I do not hold an overarching judgment as to the positive or negative essence of the phenomenon; instead, I bring a scientific understanding of geology, horizontal drilling and hydraulic fracturing processes, and an appreciation of public policy development to the study.

To reduce the potential for researcher bias during the research process, thorough documentation was employed to ensure credibility, transferability, dependability, and confirmability of research findings. Reflexivity was documented throughout using reflexive journaling. There were no ethical issues of concern associated with this study. Incentives for participation in the research were not used, and there were no conflicts of interest.

Methodology

Participant Selection Logic

The three localities (Bradford, Susquehanna, and Washington counties) were considered to be critical because of their experience with the phenomenon, widespread energy development, lack of promulgated regulations during the initial phases of drilling and hydraulic fracturing, the water resources element, and the fact that they were identified by EPA after a national selection process (EPA, 2011). Logical connections were reasonably made among these embedded subunits, and between this case and the conceptual framework developed from the literature.

This purposeful sampling strategy incorporated key informants who are local government officials with professional duties including intimate knowledge of decision-making processes associated with unconventional energy development and the opinions

of their respective communities in the evolution of the phenomenon (selection criterion). These key informants were known to meet the selection criteria based on local government websites, initial telephone inquiries, and prior participation in the EPA's (2011) study. These criteria were relevant because they defined the key informant as a person possessing the knowledge and experience essential to this study. Key informants were interviewed, and then a snowball sampling strategy with these informants was used to identify additional colleagues for further interviewing. This dual sampling approach accomplished saturation of key local decision-making, provided information-rich interviews, and in-depth insights into the local context and experience (Patton, 2002). Interviewing continued until no new information was developed.

Recruitment telephone calls to persons identified by EPA and on the county websites was performed concurrently to verify contact information and the participant's role in the organization. Each potential research participant was contacted telephonically to solicit their involvement in the study, and to obtain recommendations of other colleagues who may appropriately inform the research (snowball sampling). These individuals were also recruited for the study telephonically. A follow-up written request for participation, assuring confidentiality and informed consent, was sent by email to the interviewees who verbally agreed to participate in the study. The sample for the study included key local decision-makers who had been involved with the phenomenon in their communities; this purposeful sampling strategy ensured saturation for each locality selected.

The interview protocol necessarily involved providing a context for and explanation of the study purpose. To identify potential bias on the part of key informants, establishing a context for each respondent was important. Each interview began with context questions, including: role in the organization, responsibility in policy development/implementation, and longevity of involvement with the phenomenon. Personal background will also be relevant, including whether or not the respondent is directly involved in the phenomenon (e.g. has a drill rig on his/her own property or has refused to allow leasing) and length of residency in the locality. This baseline information was used to clarify respondent bias, establish context, and how the respondent came to possess the information he/she was sharing in the interview (criteria, evidence, reasons, and possible influence).

Instrumentation

I used in-depth interviews with key informants who had direct experience with public policy development pursuant to unconventional energy development (horizontal drilling and hydraulic fracturing) in their communities. They had crucial experience dealing with stakeholders and with resources needs during the decision-making processes on behalf of their localities. The interviews were audiotaped to ensure credibility and dependability. The interview protocol was characterized as standard open-ended interviews so that the same instrument was used consistently across participants, time was maximized, and for ease of data analysis (Patton, 2002). Each participant was sent the list of interview questions in advance of the face-to-face interview at the respondent's designated location. This approach served to minimize researcher bias, facilitate

replication of the study, and ensured comparability of responses among participants (Patton, 2002).

The first interview question was grounded in the literature (used by Anderson & Theodori, 2009, in their seminal case study research), and the last two questions have been developed by this author and were unique to this study:

1. How has horizontal drilling and hydraulic fracturing affected this community?
(The following prompts were used consistent with the case study by Anderson & Theodori, 2009):
 - What local-level benefits have occurred because of increased energy development?
 - What perceived negative impacts have accompanied increased development?
 - Have the benefits of development outweighed the costs? How and why?
2. How have the community's stakeholders influenced decision-making and public policy development in this locality?
3. What resources do you think are important for decision-making associated with the phenomenon?

Secondary data were not used to interpret or explain respondent interview data, but were used to confirm the conclusions and recommendations in this study. These data included perspectives derived from local publications.

Immediately following each interview, post interview analysis consisted of recording observations, impressions, and emergent insights obtained during the interview

process (Patton, 2002). Reflexive journaling also followed interviews. These helped to ensure the academic rigor and trustworthiness of the data collection process.

Procedures for Recruitment, Participation, and Data Collection

A combination of stratified purposeful sampling and snowball sampling was employed to recruit study participants. No inducements were used, confidentiality was assured in writing, and reciprocity included a copy of the research findings. The recruiting procedure began with telephone call introductions, and was followed by an email thoroughly describing the research design and intent (Appendix A). Another telephone call confirmed participation, and at that point, an informed consent letter was emailed to key informants (Appendix B); interviews were scheduled as soon as informed consent was obtained, and a confidentiality agreement was emailed to the participant (Appendix C). Walden University Institutional Review Board (IRB) application and procedures were used (approval number 12-20-13-0244302).

Interviews of key informants were conducted in a location chosen by the respondent. Interviews required approximately 45 minutes. The interview protocol is included as Appendix D. Minor note taking occurred during the interview process, and all interviews were audiotaped using an Olympus VN-702PC digital voice recorder. A summary of the interview was emailed to the participant for verification. A contact summary form was completed by the researcher immediately after the interview as the first phase of coding (Appendix E). This form summarized the question and response, salient observations and associated themes, and follow-up questions or clarifications from the study participant which were necessary for data analysis.

Debriefing procedures included verification of the interview transcript and follow-up questions, a reaffirmation of confidentiality, and assurance that research findings would be shared with the individual participant. The secondary data used to confirm the study conclusions and/or recommendations were published, electronic data.

Data Analysis Plan

In accordance with Smith's (1999) guidance for ideographic case study, interview transcripts were read several times so that I was able to get a sense of the data, including the chronological facts of the case, categories of data by subunits, and meaning-making of data within the subunits and the case. Consistent with Yin (2013), data analysis employed pattern matching and cross-case synthesis for embedded subunits.

An iterative process returning to the conceptual framework provided a focused analysis, offered alternative explanations for rival propositions, and increased confidence in the study (Baxter & Jack, 2008, p. 555). The context of the respondents' words were analyzed as they reflected the nature of the phenomenon and how emergent themes and patterns connected within, between, and across embedded subunits and the conceptual framework. I utilized a cross-case synthesis to link data to the interview questions and the conceptual framework. After a list of themes was generated from each transcript, themes were clustered to develop deeper meaning (Fade, 2004, p. 649). From the clustering, superordinate and subordinate themes were compiled. This process was repeated for each interview; as new themes subsequently emerged, previous interviews were revisited to verify if the themes might have been overlooked on the first analysis (Fade, 2004).

It was reasonable to expect that respondents having similar organizational responsibilities would have had a similar range of experiences; however, if one respondent's data was discrepant, an analysis of how role may differ across organizational structure was performed to help to clarify the discrepancy. Both manual and electronic coding and data management was used in this study. NVivo10 was used to manage data electronically, and to verify manual coding.

Evaluative Criteria

In accordance with Lincoln and Guba's (1985) evaluative criteria, internal validity, external validity, reliability, and objectivity are alternatively considered as credibility, transferability, dependability, and confirmability to ensure trustworthiness of naturalistic inquiry in the positivist tradition. This section also addresses the final case study component according to Yin (2013), the criteria for interpreting findings so that rival explanations may be addressed through evaluative methods.

Credibility refers to the authenticity of the study as it represents one reality, or various realities (Lincoln & Guba, 1985). Credibility was achieved by using triangulation, rich descriptions, peer review, subject matter saturation, bias clarification, a comprehensive and descriptive accounting of data collection and analysis procedures, comparison with conceptual framework (from the literature), confirmation of accuracy from study participants (member checking), exploring alternative explanations during data analysis, and ensuring internal coherence through phased coding (Miles & Huberman, 1994). Audiotaping interviews and maintaining detailed reflexive journaling and extensive field notes helped document credibility of the research.

Transferability of the research process and findings across cases, geographic/geologic setting, and similar study constructs was also employed as an evaluative criterion (Cresswell, 2009). According to Lincoln and Guba (1985), the transferability of the research findings cannot be specified by the researcher, but rather, must be evaluated by the reader to other situations. Convergence and divergence was used to contextualize findings and to assess transferability of findings.

Transferability in this study was addressed through explicitly described methods and procedures, rich descriptions, data analysis sequences thoroughly documented, biases reported, competing hypotheses considered, and retention of study data for 5 years (Miles & Huberman, 1994).

Further supporting the potential for transferability, the three localities comprising the Marcellus shale case study sample population were selected by the EPA (2011) because their characteristics reasonably extend across geographic and geologic settings, time, and evolutionary stage of the phenomenon. In addition, the research design for this study originated from the literature, specifically, the work performed in the Barnett shale by Anderson and Theodori (2009), Wynveen (2011), and Theodori and Jackson-Smith (2010); thus, some characteristics of the research design may accurately be compared with similar studies in the literature and applied to future research.

The dependability of the research was ensured by clarity and consistency of research questions and interview protocol, a thorough description of the research design and procedures, and peer review throughout the research process. As research participants were from three different localities, it was important to establish parallelism

across informants and contexts—this was established by thoroughly defining the roles each assumed with the phenomenon, and documenting consistency of responsibility and perspective (Miles & Huberman, 1994). In addition, data quality checks were implemented throughout the data collection process by the use of the contact summary form.

The role of reflexivity in case study research is based upon awareness on the part of the researcher to “subjective and experiential aspects of research” (Gilgun, 2008, p. 184). These included the researcher’s own dynamic experiences during the research process and the nuances of relationships between the researcher and key informants. Gilgun (2010) recommends reflexivity in three areas: the research topic itself, the perspectives and experiences of the key informants, and the audience to whom the research is directed. Reflexive journaling detailing the researcher’s progression of thoughts, impressions, attitudes, connections, and opinions in the three areas identified by Gilgun (2010) was maintained throughout the research process and considered during data analysis.

Ethical Procedures

Agreements to gain access to participants and/or data followed Walden University’s IRB application process and protocol. The treatment of human participants was in accordance with the IRB ethical principles of beneficence, justice, and respect (Walden University, 2010). For each participant, confidentiality and informed consent documents were obtained.

Recruitment of study participants did not include inducements. Data integrity and confidentiality was ensured through the use of nondescript identifiers attached to study participants. Electronic data storage employed NVivo10 at the researcher's home, protected with passwords. Data will be archived for 5 years.

According to Rudestam and Newton (2007), two central ethical concerns can be attached to sociological research—"fully informed consent" and an assurance that the respondents will "emerge from the experience unharmed" (p. 276). Because a study participant's professional standing may be harmed by sharing negative information about the organization, confidentiality is of extreme importance. Thus, confidentiality was ensured in writing. Individual responses and respondent identifiers were stored separately, only the researcher had access to these data, and the data will be destroyed after 5 years. Dissemination of data among the peer review board did not include individual identification information.

Summary

The research purpose was to explore the social consequences of horizontal drilling and hydraulic fracturing, how stakeholders have influenced decision-making, and what the local resource needs may be for localities dealing with unconventional energy development in the Marcellus shale. This embedded case study focused on a deeper understanding of the phenomenon through analysis of the similarities and differences within, between, and across the embedded subunits and the conceptual framework (Stake, 2006). This approach was consistent with the case study work of similar sociological studies in the literature. Academic rigor was supported by credibility, transferability,

dependability, and confirmability achieved through a variety of qualitative evaluative strategies, and ethical concerns were sufficiently addressed through adherence to IRB procedures and protocols. The purposeful sampling strategy, semi structured interviews, multiple sources of data, inductive reasoning, and cross-case synthesis of this complex issue facilitated an emergence of patterns, themes, and variables significant to the experiences and unique contexts of localities (Cresswell, 2009). The themes were used to create a deeper understanding of the broader phenomenon, as well as the relationships between context and phenomenon, and can inform public policy for other Marcellus shale localities.

Chapter 4: Results

Introduction

The purpose of this case study was to explore the social consequences of horizontal drilling and hydraulic fracturing, stakeholder influence, and resource needs of Marcellus shale localities. The case was comprised of three purposefully-selected localities as embedded subunits of analysis. Each of the counties has a governing commission comprised of three commissioners. Before interviews were scheduled, the local board was contacted, and the commissioner most knowledgeable about the phenomenon in their particular locality was asked to participate in the interview process. In addition, snowball sampling was used to include a fourth key informant, and to bring in subject matter experts to augment data collection. The Pennsylvania counties selected for the research are Bradford and Susquehanna to the northeast and Washington in the southwest as they have been the most prolific in terms of Marcellus shale production in the past 5 years. The research questions are: What are the social consequences associated with horizontal drilling and hydraulic fracturing in the Marcellus shale? How have stakeholders influenced public policy development? What resources are needed by localities for decision-making?

Chapter 4 comprises the results of the study, including: setting, demographics, data collection processes, data analysis procedures, evidence of trustworthiness (credibility, transferability, dependability, confirmability), results, and a summary section.

Setting

The key informants were purposefully-selected, elected County Commissioners—one from each of the three embedded counties (C1, C2, C3), and a fourth key informant recommended by two of the commissioners (SB1; snowball sampling). In addition, snowball sampling facilitated interviewing of four additional subject matter experts to expand on the content, adding dimension to the themes from the key informant interviews (SB2, SB3, SB4, and SB5).

All interviews were conducted on-site, at the place of business for each respondent, but in a private meeting room or office. The interviews were privileged and not influenced by the general public or other, larger organizational influences during the time they were performed. They were not held at a time when elections or appointments were being conducted or other unique political circumstances could have manipulated respondent opinions. Each respondent was asked to identify his/her bias regarding the phenomenon. All key informants indicated they were, generally, favorably inclined toward the phenomenon in their communities, but with the caveat that they expected accountability and responsibility on the part of the energy companies. None were personally involved or benefitted financially from the phenomenon at the present time.

Community Demographics

The setting for this study comprises three Marcellus shale localities in Pennsylvania purposefully selected for their experience with the phenomenon, their widespread energy development, the lack of promulgated regulations during the initial phases of drilling and hydraulic fracturing, and the water resources element (Bradford,

Susquehanna, and Washington Counties). Widespread drilling in all three counties began in 2008, and began to taper off in 2012. These localities are consistent with the ongoing study by the EPA (2011), and were specifically chosen by the agency after a national evaluation for the increased ability to regionalize and nationalize findings from these particular participants (EPA 2011). Table 1 is a summary of the demographic and key economic characteristics by county.

Table 1

Demographic and Economic Characteristics by County

Codes	Bradford	Susquehanna	Washington
Population 2013	62,316	42,286	208,206
Population % change (April 1, 2010 to July 1, 2013)	-0.5%	-2.5%	0.2%
Median household income (2008-2012)	\$44,650	\$46,815	\$53,326
Persons below poverty level % (2008-2012)	14.1%	12.2%	10.7%
Industry Employment (2008-2012):			
Agriculture	6.2%	7.3%	2.1%
Construction	7.2%	8.3%	7.6%
Manufacturing	20.4%	14.8%	11.1%
Retail Trade	11.6%	11.3%	11.8%
Transportation and warehousing, and utilities	6.2%	6.2%	5.5%
Professional, scientific, and management, administrative, and waste management services	5.3%	6.3%	9.1%
Educational services, health care, and social assistance	24.6%	21.2%	24.5%
Arts, entertainment, recreation, accommodation and food service	5.4%	7.7%	9.7%

NOTES: U.S. Census Bureau 2014 and American Community Survey (ACS)

Bradford County is located in the northeast corner of the Commonwealth of Pennsylvania where it shares a border with New York. Bradford County is governed by a board of three popularly elected commissioners. Notable differences as compared to the other two study localities are: the poverty level was higher between 2008 and 2012, percentage of the population employed by the manufacturing sector was larger, and median household income was smaller. As of August 19, 2014, the county ranked first in number of unconventional gas extraction wells drilled in the state (1,293) between 1/1/2000 and 8/1/2014 (Pennsylvania DEP, p. 1).

Susquehanna County is geographically positioned immediately to the east of Bradford County, also sharing a northern border with New York. Like Bradford, it is also governed by a board of three popularly elected commissioners. Susquehanna County was the least populated of the three study counties, experienced the largest population change between 2008 and 2012 (-2.5%), and has the largest percentage of its population employed in the agricultural and construction sectors. As of August 19, 2014, the county ranked third in the state in the number of unconventional gas extraction wells drilled (996) between 1/1/2000 and 8/1/2014 (Pennsylvania DEP, p.1).

Washington County is the largest of the three study counties in terms of population, and is geographically located in the southwestern portion of the Commonwealth near the city of Pittsburgh. It is also governed by a popularly elected board of three commissioners. Notable differences, as compared to the other study localities, include: a population increase from 2008 to 2012, as well as higher median household incomes reported during that time, with significantly lower percentage

employed in agriculture with the highest employed in professional/scientific/management and arts/entertainment/recreation industries. As of August 19, 2014, Washington ranked second in the state in the number of unconventional gas extraction wells drilled (1,104) between 1/1/2000 and 8/1/2014. According to the Pennsylvania Department of Environmental Protection Office of Oil and Gas Management database, there were a total of 8,251 total unconventional wells drilled in Pennsylvania during that time period (includes inactive, plugged, reclamation complete, etc.).

Data Collection

Initial data collection was comprised of semi structured interviews with key informants in accordance with the interview protocol included in Appendix D. Interviews were conducted at the workplace of each key informant, audiotaped using an Olympus VN-702PC digital voice recorder, minor note taking was performed, and a contact summary form was completed by the researcher immediately after the interview was concluded to ensure credibility (Appendix E). Secondary data were used to confirm the interview data, study conclusions, and recommendations. Subject matter expert interviews were conducted to augment key informant interviews (SB2/3 and SB4/5). These interviews provided additional detail about local issues that key informants had identified as significant (zoning, planning, nuisance problems experienced across the local levels of government). There were no unusual circumstances encountered during data collection. Table 2 is a summary the pertinent interview information conducted as part of this study.

Table 2

Key Informant Interview Summary Information

	Date	Time	Duration	Type
C1	3/10/14	12:43pm	1:15:42	Audio
C2	3/11/14	10:03am	43:23	Audio
C3	3/12/14	09:31am	55:32	Audio
SB1	3/10/14	08:48am	2:26:03	Audio
SB2/3	3/12/14	08:54am	33:21	Audio
SB4/5	3/12/14	13:11pm	35:34	Audio

The characteristics of key informants relevant to the study include the job position/responsibilities, the time each has served in his/her official capacity, and how long each individual lived in/has had knowledge of the particular locality. These characteristics are important for the context they provide in how each key informant comes to possess the knowledge shared, and the unique lens they provide the case.

County commissioner C1 has served on the commission just over two years and has been a resident of the county for more than 10 years. He worked professionally as a successful businessman. His duties as commissioner include setting policy and operational procedures for the county, budgeting and planning for various departments including treasurer, courthouse, children and youth, emergency services, jail, and sheriff. C1 sees the energy industry as something that “could be great for our county but it has to be administered well—accountability.” Because of his business background, C1 was very knowledgeable about economic aspects of the phenomenon, including regulatory influences, finance and budgeting as essential keys to the county becoming self-sustaining with the phenomenon, and considers himself “forward-thinking and business-centric.” He reported having no personal bias and no involvement in the industry.

County commissioner C2 has served on the commission just over two years, lived in the county “his whole life” and is a “5th generation” county resident. He described his county commissioner responsibilities as “overall county management.” C2 had a keen general knowledge of the county’s history, including business and agricultural development, infrastructure, population, and his view of the industry’s progressive influence over time in the community. He reported having a well under his property (not operational), but having no personal bias.

County commissioner C3 described his responsibilities as “setting county policy and procedures,” has served on the commission for 10 years, and “was born and raised here.” C3’s longevity in both the community and on the commission provides an exceptional knowledge base as a key informant. C3 has an extensive background in public service, is an avid outdoorsman, environmentalist, and resource conservationist. As a county commissioner, he reported a positive stance toward the industry as a partner in the community serving his constituency, but no personal bias for/against the industry.

The three county commissioner key informants represent the broad spectrum personally and professionally when compared to the conceptual framework—political diversity, background, interests, geographic, and professional experience although they are all serving in essentially a similar capacity at the present time as county commissioners.

The fourth key informant, SB1, was recommended for interviewing by two of the three county commissioners because of his extensive and detailed knowledge of the phenomenon at both the county and local levels. In the northeast region of Pennsylvania,

the county commissioners and localities rely on his agency's work to inform their economic development, planning, infrastructure, housing, and other social decision-making strategies. He has been doing this work for more than 20 years, and is uniquely positioned outside of the political realm, unlike the county commissioners. He works with government agencies at all levels, as well as with homeowners, energy company representatives, non-profits, and businesses. He reports that he does have moderate bias in favor of the phenomenon because of the positive benefits he believes it has brought to the community.

Data Analysis

In accordance with Smith's (1999) guidance for ideographic case study, interview transcripts were read several times so that the researcher was immersed in the data. Interview transcripts were then transcribed into text format and entered into NVivo10 as internal Microsoft Word documents. An iterative process returning to the conceptual framework provided a focused analysis, offered alternative explanations for rival propositions, and increased confidence in the study (Baxter & Jack, 2008, p. 555). Thus, the context of the respondents' words were analyzed as they reflected the nature of the phenomenon and how emergent themes and patterns might be connected within, between, and across embedded subunits and the conceptual framework.

The nodes created in the software were consistent with the conceptual framework: economics, environmental (water resources was combined with environmental as the issue was not mentioned during any of the interviews), political issues, ethical issues, public health and safety, and the regulatory construct. Nodes represent issues and

concepts derived from the conceptual framework, whereas codes are pieces of data (text) from the interview transcripts which relate directly to these larger concepts. The occurrence of codes by node according to the studied county is provided in Table 3.

Table 3

Conceptual Framework Nodes and Codes by County

Codes	Bradford	Susquehanna	Washington
Economics	56	67	15
Environmental	7	8	10
Political issues	39	46	12
Ethical issues	11	21	8
Public health and safety	4	9	12
Regulatory construct	15	25	19

I used cross-case synthesis to link data from the interview questions to the conceptual framework and themes were clustered to develop deeper meaning (Fade, 2004, p. 649). From the clustering, superordinate and subordinate themes emerged. This process was repeated for each interview and revisited for prior interviews to ensure consistency (Fade, 2004). A review of the interview questions and responses will demonstrate how the codes and themes emerged during the data analysis process, and respondent quotations will support the importance of these themes in the results section.

Articles from local publications were also reviewed, acquired through a LexisNexis Academic database search comprised of various sources including newspapers, newswires, press releases, newsletters, magazines, law reviews, academic journals, industry trade publications, web-based publications. In addition, the Daily Review (Bradford County, Pennsylvania) and The Times-Tribune (Susquehanna County,

Pennsylvania) were also queried on search terms from the conceptual framework and themes from the subordinate themes by county. More than 2,545 additional data sources (from 2010 to 20014) were used for triangulation from various local publications.

Table 4 summarizes the superordinate themes, each one corresponds to the following: positive social consequences, negative social consequences, stakeholder role in public policy, and resource needs; the subordinate themes are also identified below each superordinate theme; the number of corresponding codes occurring within the data are provided by source.

Table 4

Superordinate Themes and Subordinate Themes by County

Themes	Bradford	Susquehanna	Washington	Publications
Sustainability				
Economic	56	67	15	381
Community identity	5	10	20	2
Family/generational stability	3	20	20	83
Value-added	12	12	0	51
Tax benefits	5	7	0	247
Training/education	0	0	5	64/93
Environmental	0	0	10	501
Adaptability				
Nuisance issues	6	5	12	105
Infrastructure	9	1	6	150
Ethical issues	11	21	8	222
Autonomy				
Planning and Zoning	2	8	19	108/40
Education				
Information	28	30	6	405
GIS	3	3	4	3
Extraction history	0	0	5	63

A review of the interview question and responses in the following section will reveal how the nodes connected from the interview transcripts to the conceptual

framework cross-case, clustered into subordinate themes, and began to shape the emergence of superordinate themes.

Data Analysis - Interviews

Positive Social Consequences Question-Sustainability Theme.

The first interview question began by inquiring generally “how has horizontal drilling and hydraulic fracturing affected your community,” and more specifically, “what local-level benefits have occurred because of increased energy development?” Each response among key informants to this interview question was associated with the node, “economics.” The differences in emphasis created subordinated themes and the similarities produced the superordinate theme, sustainability. Under “economics,” key informants discussed: increased business development (for existing and new businesses), wealth creation, new jobs, reduced taxes, ripple-effect from royalty payments, economic stability, sustainable employment opportunities which allowed the population to remain in the area, support to the agricultural economy by keeping land in large parcels, keeping youth in the area providing generational stability, value-added products like compressed natural gas, financial help to senior citizens during difficult economic times, and new infrastructure in the community. The subordinate themes of community identity, family/generational stability, value-added benefits derived from the resource, tax benefits, training/education, and environmental protection were all related to the positive social consequences under “economics” and were in support of a sustainable economy and sustainable future for these communities.

Negative Social Consequences Question-Adaptability Theme.

The second interview question was “what negative social consequences has the community experienced?” The five other nodes from the conceptual framework are examples of potential negative social consequences and data were coded accordingly. The key informants consistently identified temporary nuisance issues and damage to infrastructure as negative social consequences, including: traffic, congestion, noise, damage to roads, a lack of adequate housing, transient workers, and slight increase in crime. Ethical issues were also associated with perceived unequal treatment of homeowners by energy companies (leases and post-production costs, minimum royalties). All key informants emphasized that the negative social consequences were temporary, lasting only during the “ramp-up stage” (9-12 months) when construction and drilling begins in the community. The subordinate themes of nuisance issues, infrastructure degradation, and ethical issues are not permanent, they are issues that a community and its leaders can have some control over, thus, adaptability is an appropriate superordinate theme for negative social consequences.

Stakeholder Question-Autonomy Theme.

The next interview question sought to understand how the community’s stakeholders influence decision-making and public policy development. In the Commonwealth of Pennsylvania, the decision-making ability of counties, cities, boroughs, townships, and villages was believed to be particularly influenced by various stakeholder groups because of the comparably fragmented state government-local structure. This fragmented structure was a topic that emerged during each key informant

interview. SB1 noted that “there are 2,700 municipalities in Pennsylvania in some form” and “from the standpoint of autonomy” it is “both a struggle and a benefit.” Responses from the key informants were fully consistent—the stakeholders they considered most crucial were the townships and municipalities within their counties. The subordinate theme that emerged from all key informants was planning and zoning, because these issues relate most directly to controlling the phenomenon at the local level (where the wells are drilled). The emergent superordinate theme from the stakeholder question was autonomy; at both the local and county level in Pennsylvania, the majority of the citizenry prefer autonomy in matters related to this phenomenon. Subject matter experts were subsequently interviewed pursuant to zoning and planning in one of the three localities; the details of these interviews are discussed further in the Results section.

Resources Question-Education Theme.

The final interview question was intended to determine what resources are most important for local level decision-making associated with the phenomenon. For this study, resources that were considered as potentially important included equipment, human resources, and informational resources. Decidedly, information and education of community decision-makers emerged as the most significant needed resources in this category. Key informant responses included: education, information (economic and demographic data), logistical and technical data from the energy companies, and GIS to know what infrastructure and data exists in the community. Information and GIS are recommended resources for local decision-makers to guide public policy development pursuant to this phenomenon. Extraction history also emerged as a significant subordinate

theme for Washington County because that experience was a key resource. It enabled Washington County to negotiate more effectively with the energy companies initially, and to have more of the education and training resources in place to support the industry at the outset of drilling. Information, GIS, and extraction history support the superordinate theme of education as the fundamentally important key resource most needed for local level decision-making.

The responses among the key informants were consistent with the conceptual framework and were consistent with each other. As a result, it was determined that there were no discrepant cases among the data.

Evidence of Trustworthiness

Evidence of Trustworthiness

In accordance with Lincoln and Guba's (1985) evaluative criteria, internal validity, external validity, reliability, and objectivity are alternatively considered as credibility, transferability, dependability, and confirmability to ensure trustworthiness of naturalistic inquiry in the positivist tradition.

Credibility refers to the authenticity of the study as it represents one reality, or various realities (Lincoln & Guba, 1985). To achieve credibility, I used rich descriptions, peer review, subject matter saturation, bias clarification, a comprehensive and descriptive accounting of data collection and analysis procedures, comparison with conceptual framework (from the literature), confirmation of accuracy from study participants (member checking), exploring alternative explanations during data analysis, and ensuring internal coherence through phased coding (Miles & Huberman, 1994). Audiotaping of

interviews and maintenance of detailed reflexive journaling and field notes have documented the credibility of the research. I also triangulated the interview data with a LexisNexis Academic database search comprised of more than 2,500 articles from sources including newspapers, newswires, press releases, newsletters, magazines, law reviews, academic journals, industry trade publications, web-based publications.

Transferability of the research process and findings across cases, geographic/geologic setting, and similar study constructs is also employed as an evaluative criterion (Cresswell, 2009). According to Lincoln and Guba (1985), the transferability of the research findings cannot be specified by the researcher, but rather, must be evaluated by the reader to other situations. Transferability in this study has been addressed through explicitly described methods and procedures, rich descriptions, data analysis sequences thoroughly documented, biases reported, competing hypotheses considered, and the retention of study data for 5 years (Miles & Huberman, 1994).

However, further supporting the potential for transferability, the three localities comprising the Marcellus shale case study sample population have also been selected by the EPA (2011) because their characteristics reasonably extend across geographic and geologic settings, time, and evolutionary stage of the phenomenon. In addition, the research design for this study originates from the literature, specifically, the work performed in the Barnett shale by Anderson and Theodori (2009), Wynveen (2011), and Theodori and Jackson-Smith (2010); thus, some characteristics of the research design may accurately be compared with similar studies in the literature and applied to future research.

To ensure dependability, clear and consistent research questions and interview protocols were employed, a thorough description of the research design and procedures was maintained, and peer review was used throughout the research process. As research participants have been from three different localities, parallelism across informants and contexts has been established by thoroughly defining the roles each has assumed with the phenomenon (Miles & Huberman, 1994). In addition, data quality checks have been implemented throughout the data collection process by the use of the contact summary form.

To ensure reflexivity, I maintained a reflexive journal documenting my awareness of “subjective and experiential aspects of research” (Gilgun, 2008, p. 184) (to include the research topic itself, the perspectives and experiences of the key informants, and the audience to whom the research is directed) throughout the research process (Gilgun, 2010).

Results

The research question for this study is: What are the social consequences associated with horizontal drilling and hydraulic fracturing in the Marcellus shale and how have stakeholders and resources influenced decision-making and public policy development at the local level?

Positive Social Consequences

When asked whether the benefits of energy development outweighed the costs, three out of four key informants responded with exactly the same word, “absolutely.” The fourth key informant said, “Definitely.” When asked specifically about positive social

consequences associated with the phenomenon, the key informants overwhelmingly responded that the economic benefits are the number one positive social consequence. The economic benefits included such things as new businesses, job creation, tax reduction, economic stability, homeowner investment and spending, royalty payments, infrastructure improvements and expansion, increase in social services, donations from the industry to the community (e.g. new libraries, hospital, community college investment, etc.).

Positive social consequences from economic benefits are not purely comprised of monetary “value,” however. The superordinate theme associated with positive social consequences is sustainability. From the positive economic social consequences described by the key informants, other positive social consequences emerged, including: training/job opportunities for youth to stay in the area thereby creating more generational family stability, enhanced financial security for senior citizens, the development of value-added products for use in the community prior to export (quality of life), the advancement of sustainable economic development, and the increasing capacity of the community to preserve its individual identity.

C1 explained, “The education in the area, most students that graduated high school left the area to find work elsewhere, they couldn’t get a sustainable job here. I’ve got some of them that are making \$70,000-\$80,000 fresh out of high school they are making more money than their parents have, getting benefits and retirement. And they stay home.” C1 also noted the economic benefit that has occurred by reduced heating oil costs to senior citizens. “Because it’s no longer a choice do I buy heating oil or buy my

prescriptions; now I can buy my prescriptions and not have that huge expense.” “So not only the economic benefits but the opportunities for people to stay in the area, for families to stay together, children, grandchildren, we have pride in employment now.” The meaning from positive economic social consequences in this community is sustainability of economic growth and stability of families for generations.

The sustainability theme was echoed by C2 for long term business development for his agricultural county. The industry has allowed farmers “to update equipment, update their operations, put money back into the farm that they otherwise would have had to borrow.” C2 noted “the business development that’s long-term business development taking place in our county because of the proximity to the resource is going to benefit us years and even decades and probably even generations into the future.” The industry has allowed his community to maintain its agricultural identity.

C3’s focus on economics was somewhat different, likely the result of his county’s resource extraction history (steel mills and coal mining) and different geographic location (southwest Pennsylvania). He described the economic benefit to his county in terms of “monetizing assets.” “I do not want us to lose our country charm. And the gas and oil industry has come in and allowed us to keep that. What I mean by that is, before, 10 to 15 years ago, the only way a farmer or person in the agricultural community could monetize their assets is by selling off to developers, putting a strip mall on it, putting a housing plan on it, or a parking lot. Now, they come in and monetize their assets—they are taking an acre, pumping down, pulling out the money, and then, within 9-12 months, that footprint is a well-manicured yard. And those people are not developing that property

into a concrete jungle. That's what I think is one of the biggest assets that we are seeing environmentally. We were raped and pillaged going to coal and manufacturing steel. We polluted our rivers and are still dealing with acid mine drainage from the coal industries in the 1920s and 1930s, we learned from that and it is not happening now." He continued, "not only from the monetary aspects, the increased revenue it's brought in, the jobs it's created, the wealth it's created, the employment it's created it has also helped us protect our environment, I will be very blunt." C3 was able to articulate a similar sentiment that C1 and C2 were referring to: "This industry is helping us keep our identity—we are an agricultural community. And there are farmers out here that own 100-200 acres and they were dirt poor, and the only way they could monetize that and the only way they could live was working another job and then selling that property off to developers and then we end up having housing, parking lots, strip malls. Now this and you don't have to do that." The issue of community identity was common to all key informants but was most clearly articulated by C3. C3 also discussed, from a personal perspective, his grandchildren and passing environmental resources down to them (generational/family subordinate theme).

SB1 was the most detailed of all key informants with regard to the economic development information. His primary focus was on the "value-added" aspect of the phenomenon, which is how communities are benefitting from and using the resource before it leaves the area. "Susquehanna County, you are going to find, is number one on the list—they have some of the most prolific wells in the entire United States. For the first time, they have a company coming in now and franchising areas and bringing pipes into communities so that the new hospital has gas, their first high school has gas, and

we're looking at what we're calling value added—natural gas distribution is value-added in itself—CNG stations, coming up, used for vehicles, that's really the value proposition here. Communities are actually realizing the value of the resource themselves.” “What we're seeing right now with all these value-added projects, are projects taking us to the next level of sustainability as far as the dollars here, the jobs here, and the investment being here, and none of them are cheap.” SB1 also noted “A lot of people had little local businesses that got a good shot in the arm. Again, that gave opportunities to keep some of the youth in the area, we have a lot of youth that leave the area, some education opportunities were formed around it in the region.”

Negative Social Consequences

Negative social consequences reported by key informants were consistent, and most of them related to issues associated with the “ramp-up stage” of drilling in their communities (the first 9-12 months). These included: traffic congestion, dirt, noise, damage to infrastructure (roads), heavy equipment, newcomers (population increase), transient workers, impacts to school systems, slight increase in crime, lack of adequate housing and other adequate infrastructure (water, sewer, and roads), lack of trained workers to support the industry (1-3 years). Some of the negative social consequences did, however, also relate to unfair/unequal treatment of homeowners by energy companies (leases), post-production costs, and minimum royalties and some minor negative environmental impacts.

C3 said that negative consequences are associated with the drilling phase of the phenomenon, “anywhere from 9 months to 12 months.” C3 differentiated between real

and perceived negative impacts, “When they come in to drill with derricks and big equipment, lots of traffic, lots of raw water trucks, that’s real; the traffic, the congestion, that’s real. But it is embellished a little bit because it’s only here for a very short period of time, it’s temporary, and it’s not constant. We talked about traffic congestion, dirt that is concentrated into maybe a month to 2 months. Where it is concentrated, they do it almost 24 hours a day, 7 days a week, so that is real but it is embellished that it will be a lifetime. It is not a lifetime, once you get through it, it is done.”

SB1 also mentioned a fundamental lack of understanding among property owners, initially, and people signing “bad leases” because “we were neophytes.” “We didn’t understand the industry. So people signed bad leases, some leases that were not in their best interests that were in the company’s best interests. They were written by the companies. They weren’t fair.” He also discussed the problem with post-production costs, and the increasing involvement of the county commissioners to make sure that landowners are protected. He noted the problem with post-production costs being “a little hidden clause minus, minus, minus, plus market enhancement which is another clause in there, all ways for them to subtract money, which they can do. But they really shouldn’t subtract it out of the landowner’s share.” SB1 also described some of the perception issues having to do with environmental impacts. “Most people in Philly don’t want the industry because they think it is polluting all the groundwater and streams and fish. Again, it’s a perception problem that our legislators in Philly have because they don’t have time to really understand what’s going on. And so it is a forever-educational process.”

Stakeholders

The second research question is intended to determine how stakeholders and resources have influenced decision-making and public policy development. This is important because other counties faced with similar positive and negative social consequences may be able to work with their stakeholders, and having access to resources, they could be better positioned to mitigate negative consequences and leverage positive outcomes.

All the key informants included in the study characterized their key stakeholders as their local level constituents—the representatives from the townships and boroughs. Given the structure of the Commonwealth of Pennsylvania government, county commissioners serve as a liaison between and among local/municipal stakeholders and state level government. Washington County also included the local chambers of commerce, the Penn State Coop, (who assist farmers in decision-making), and local conservation districts (watershed protection) as additional stakeholders. In Washington County, these additional stakeholders primarily served an educational and networking role in the community.

C1 clearly expressed that his stakeholders desired to operate independently, and he addressed zoning, specifically, saying that his stakeholders were not in favor of widespread zoning. “We did look, at one time, of doing a whole bunch of townships to see if they wanted to do a coalition of zoning and people said, ‘no, we don’t want more rules.’ Everybody wants that ‘special zoning’ that pertains to you but not to me. When they start going through the process, the comprehensive plan, that’s what you have to do

to create zoning, when people start getting in to that process that's when they say, 'we don't want that.'”

Like C1, C2 described how his county's stakeholders, the municipalities, have preferred autonomy in their planning and zoning policies pursuant to the Marcellus shale and related social consequences. He said there were no common zoning problems or planning issues among his stakeholders that the county has been asked to address. “To be perfectly honest with you, there have not been a lot of issues regarding (zoning and related public policy) in our county, there just hasn't.”

Planning and Zoning

Following interviews with key informants, it was evident that the research question about stakeholders and public policy was commonly associated with issues of zoning and planning. Using snowball sampling, I had the opportunity to interview subject matter experts SB2/SB3 (together) and SB4/SB5 (together) but in separate interviews. These personnel are, respectively: a county director of administration, county commissioner/former township supervisor, a county planning commission director, and an employee of one of the county planning commissions. All have an opportunity to interact with stakeholders on a daily basis, and know, firsthand, the commonalities/differences in planning and zoning issues among stakeholders in the county. While these data may not be representative across all three counties in this study, they may be applicable to other counties as determined by the reader.

SB3 described the phased approach to construction and production as the impetus behind many of the nuisance ordinances. “The first thing is construction versus

production, there are two phases. In construction, there is a lot of turmoil because something new is coming into a community—trucks, dirt, machinery, late night lights. There is a whole change in the environment, which is what people normally react to.” He described the steps as “educate, communicate, and legislate.” The initial ordinance “was very shallow because of the Oil and Gas Act, you can’t really do too much at the local level.” SB3 said, “From a county standpoint, we can help coordinate and educate, but I don’t think anyone wants to step on the municipalities’ toes—they have their jobs to do.” “However, as we look at what happened with Act 13 and they challenged the local ordinances and the zoning issues, which is a valid issue.” “Who knows the community better than the local representatives? They should. Therefore, it should be a combination of some broad guidelines of what you should not do and then let the local municipality take it from there down to my area where do I want drilling in my area.” SB2 said, “I think, on the county level, if we have a role, it’s more of an advisory than it is legislative one. We have so many different communities, rural and suburban, if the county came in and tried to say, ‘this is what you have to do,’ nobody likes that.”

The next interview took place with SB4 and SB5 from the county planning commission. These experts described the evolution of the ordinances across the county, as the drilling activity has spread across the county. SB4 described, “Some municipalities have been reactive and now what we’re seeing is that more are becoming proactive and making sure that the ordinances are in place. There are a lot more players, there is legislation out there to provide them with the funding, so now, several years later, they are making sure that their ordinances are up to speed. Localities are in the process of

upgrading ordinances and trying to get some controls in place.” SB5 described the nature of the commonalities among the ordinances as related to “setbacks, nuisance issues.” SB4 explained, “Nuisance issues are the common thread, preventing nuisance, noise, dust, storm water. Safety is the other thing, especially like contact information. That was one of the things, home, emergency contact information. Now you have a list of all subcontractors working on the site, so when you see that truck out there you know it’s related to that site.” “Job training, public safety, and emergency contact information. Health and safety plan stuff is addressed by state law, but locals want that information too. So now the municipality gets tons of information. And it evolved to they are responsible for the subcontractors. I think a lot of them put that into their other industry standards so it actually helped their old ordinance get better.”

SB4 suggested, “If you have some sort of ordinance, at least then, the companies have to come to you and start that open dialogue, and that’s just relationship-building as municipal officials—that’s really the most important thing. It’s nice to have the ordinance, and you need to have protections built in, but you don’t just want to stand behind that.” Both SB4 and SB5 emphasized the need for stakeholders to be proactive about ordinance development before drilling becomes widespread. They also emphasized the importance of maintaining the following information: well site locations, owner, coordination with emergency services, mapping.

SB4 and SB5 also expressed concerns about surface impoundments and zoning, reclaiming well pads, drilling new horizontal wells, pump stations on private property

and the effect these things will have in the future on easements, zoning, and liability.

Many issues remain unresolved by public policy at this time.

Resources

Regarding important resources needs for public policy decision-making, all key informants agreed that information is the most crucial resource. C1 replied, “The first and foremost thing that has to happen is you have to become educated. The second step is getting you to understand what the gas industry is all about.” C2 answered the resources question by responding, “Again, it goes back to information gathering, traveling, talking to other areas of the country that have developed energy historically. You can’t get too much information, study, study, study. Even then, you’ll learn only so much because it is true, the technology is advancing such that the experience we have here is not the same experience.” C3’s reply was, “The most important resource for us to have globally is information.”

SB1’s response to the resources question was, “The first thing is good data. The problem you have is fundamental demographic information about our county during the census was bypassed with this industry. This happened so fast, back to the original issue, that so much happened in such a short period of time, I couldn’t have told you what the population of this county was. All the fundamental demographic information that was useful to appeal to the powers that be, from a policy standpoint, well, we don’t have those numbers. In many ways, the state said, ‘just tell us what you need.’ We told them what we needed, but we couldn’t substantiate it with data.”

All key informants indicated that information was the most important resource for public policy decision-making pursuant to the phenomenon. Additional subordinate themes that emerged were GIS and extraction history (Washington County). GIS is a resource for localities to consider, if possible, for managing data. Extraction history is another resource some localities can benefit from because it provides a level of existing experience working with energy companies and a framework of reference for environmental resources management.

Similarities and Differences

Similarities and differences among the embedded sub units are observed with several subthemes. Washington County noted training/education and environmental among the positive social consequences, whereas the other study localities did not; in addition, planning and zoning (19) was higher for stakeholder issues, and extraction history was noted for resources and was not mentioned for the other two study localities. Washington County's extraction history with coal mining and the steel industry is likely to make training/education and (lack of negative) environmental outcomes a positive social consequence, planning and zoning a more salient stakeholder concern, and extraction history a beneficial resource for public policy development. In addition, Bradford and Susquehanna Counties are just beginning to realize the positive value-added advantages of utilizing the resource in their communities and the tax benefits, while Washington County is farther along in the evolutionary cycle of the phenomenon. Ethical issues and political issues have been more salient in Bradford (11) and Susquehanna (21) Counties than in Washington County (8). Differences in the local

experience, as observed with Washington County, may also be attributed to its geographical proximity to a major metropolitan area (Pittsburgh), confirming earlier research findings by Brasier et al. (2011).

The similarities among the embedded subunits were consistent in negative social consequences with nuisance issues and infrastructure, although there were minor differences in emphasis on the severity of these issues. This is reasonably explained by the inherent political sensitivity attached to how individuals communicate negative issues or problems to outsiders. Similarities also existed among the localities regarding stakeholder autonomy, and in the need for informational resources for public policy decision-making and the importance/necessity of GIS as a tool for localities. All agreed that the benefits of unconventional energy development outweighed the costs, without hesitation.

Secondary data from publications (used for triangulation) suggested confirmation of the primary thematic data. Additionally, these data reflected the media's interest in the phenomenon, particularly with respect to the socially and politically sensitive issues such as environmental issues (886), economics (381), tax benefits (247), ethical issues (222), the need for information (405), and training and education (249), planning and zoning (108/40), family/generational stability (83).

The differences among the embedded subunits suggests that extraction history is an important factor in what resources a locality needs for public policy development; it also appears to influence a community's perception of positive social consequences regarding environmental outcomes and preparing the workforce of the community to take

maximize advantages of the phenomenon. The similarities reveal that all three communities (who characterize themselves as primarily “rural/agricultural”) regard family and general stability and protection of their community identities as a positive social consequence derived from the economic benefits of this phenomenon, in particular. Finally, the value-added benefits that Bradford and Susquehanna Counties are realizing are comparably new, and are enabling those communities to achieve additional economic advantages and quality of life benefits early on in the phenomenon’s evolutionary process.

Summary

The purpose of this embedded case study was to explore the social consequences of horizontal drilling and hydraulic fracturing in the Marcellus shale, including the role stakeholders have assumed in influencing public policy and the resources needs of localities for decision-making. The study found that the positive social consequences are largely associated with economic benefits. These economic benefits then provide for other things. Communities are finding they are able to keep their unique, individual identities through sustainable economic growth and new business opportunities which support families and bolster generational stability; adding value to the resource through distribution/usage systems in the community enables residents to enjoy the benefits of the resource in their communities prior to export; residents realize the benefits of reduced taxes, further facilitating an economic ripple effect within the community.

The study also found that the negative social consequences are temporary, and the key to managing them is a community's ability to adapt. Nuisance issues experienced during the initial 9-12 months, and the ethical and regulatory hurdles related to the evolutionary stages of the phenomenon can be effectively managed using public policy tools.

The stakeholder and resources aspects of the study were intended to characterize how each influenced the development of public policy in the study counties. The emergent theme regarding stakeholders was that of autonomy, in fact, stakeholders only networked to the extent that it benefitted the development of their own policy. With regard to the resources question, information was the emergent theme from key informants, with each citing the need for data and education as paramount for themselves, their stakeholders, and their constituencies, particularly at the beginning of the phenomenon's evolutionary process.

How these study results relate to the literature, what the implications are for positive social change, and what these findings may mean for other localities in the Marcellus shale will be explored in Chapter 5.

Chapter 5: Results

Introduction

The purpose of this case study was to explore the social consequences of horizontal drilling and hydraulic fracturing, stakeholder influence, and resource needs of Marcellus shale localities. The study was conducted to assist localities with the challenges of leveraging positive outcomes and mitigating negative consequences. The Marcellus shale is expected to account for nearly half of domestic natural gas production by 2035 (U.S. Energy Information Administration, 2012).

I found that the most significant positive social consequences are economic, and are related to themes of sustainability. The positive social consequences are sustainable in many ways: in the types of employment the phenomenon brings to the community, jobs which enable youth to remain in the area, thus providing generational support to families; new businesses that provide diversity to the local economy; the value-added aspects of the phenomenon which enable the community to realize, firsthand, the benefits of the resource and also provide long-term economic potential.

The negative social outcomes are temporary, with adaptability being essential to mitigation. Because these are temporary, the ability of the community to adapt to the first 9-12 months of the “ramp-up” stage in the phenomenon’s evolutionary process is essential to mitigating the negative consequences. The “unethical” issues related to leases, royalties, and regulatory hurdles are part of the “learning curve” of the community as it adapts and learns how to negotiate with the energy companies and develop public policy tools to manage negative consequences.

I also found that stakeholders in the three counties favored autonomy in matters of public policy development, and that the most critical resource key informants recommend for a community new to the phenomenon is information. The education of decision-makers and stakeholders is a vital first step in the process when a community decides to undertake horizontal drilling and horizontal fracturing on a widespread scale. The information needed by decision-makers includes demographic and economic data about the community itself, and extends to planning and logistical data from the energy companies working in the area. Extraction history is a resource some communities may have and others may not, but it has been demonstrated that experience is beneficial in leveraging positive consequences and mitigating negative outcomes.

Interpretation of Findings

In comparison to the seminal work on social consequences in Texas' Barnett shale by Anderson and Theodori (2009), the findings of this study were consistent with positive social consequences tied to economic prosperity and improvements in public services for communities where the phenomenon was new. The theme of disparities among wealth and power was not significant but mentioned as "unequal treatment" having to do with leases, royalties, and post-production costs pursuant to energy company agreements; the theme of social disruption emerged as significant and, in fact, translated across geographic boundaries to the Marcellus shale (a recommendation for future study). This study also confirmed Theodori's findings regarding dispelling misperceptions through creating partnerships with stakeholders, clear communication, and public education, and also confirmed Theodori's 2012 study linking resident support for industry when energy

companies go beyond minimum legal/regulatory requirements and implement better information-sharing practices. The significance of this study in confirming some of Theodori's findings is that they cross geographic boundaries and geologic settings.

This study also confirms Wynveen's Barnett shale work (2011). Emergent subthemes in her case study included: justice and equity, quality of life and community identity, health and safety, traffic and road conditions, citizen and stakeholder involvement, and power and politics (p. 16). In this study, her themes were confirmed, the most significant of which is community identity. The reason this is significant is because the geographic settings are different but the emphasis of the key informants was the same. So, regardless of what the community's identity might be, a community's interest is in seeking to safeguard that identity when faced with challenges associated with the phenomenon.

Theodori and Jackson-Smith (2010) found that social and environmental perception variables were a key factor in formation of resident attitudes. Although this study found that environmental perception variables were less important, it did confirm that better communication among government regulatory agencies and energy companies with key stakeholders does influence public perception and resident attitudes.

This study confirmed findings in social science work in the Marcellus shale performed by Brasier et al. (2011), specifically, the consistent local economic impacts and social impacts identified in the Pennsylvania counties included in that study. These findings are not necessarily surprising, as two of the counties (Bradford and Washington) are similar between the two case studies but 3 years had elapsed between when each

study was performed. This study also confirmed that extractive history plays an “important role” in the administration of county public policy regarding the phenomenon (p. 55).

Because appropriate and reliable measures of adverse health outcomes and environmental degradation were not a part of this study, these findings cannot inform Liu et al.’s 2012 work. However, several of Weigle’s (2010) research findings on resilience, community, and perceptions of Marcellus shale development in the Pennsylvania Wilds were largely confirmed by this study. The socioeconomic concerns were fully validated by all three counties included in this study, including: jobs, economic impacts, housing, development, sprawl, infrastructure impacts, road degradation, etc. The government and planning concerns surrounding the fragmented nature of Pennsylvania’s structure was also a concern voiced by key informants in this study, however, the theme emerging from this study was autonomy. The stakeholder communities were not looking for legislation or guidance from state government, but rather, preferred to operate autonomously in development of zoning and other public policy issues. Regarding the other two subcategories Weigle noted that environmental impacts and health and safety, these were not particularly noteworthy in this study. Weigle reported that “environmental impacts were also major concerns,” but this was not herein confirmed (p. 9). Additionally, adverse impacts to the health care systems and the potential for adverse impacts to the health and safety of residents resulting from the spread of infectious disease(s) was not a concern expressed by key informants in this study (p.10).

Jacquet (2012) explored how natural gas extraction can reasonably be compared to solar and wind power alternatives, given variables of geographic proximity, economic influence, and environmental attitudes. This study can confirm Jacquet's finding that "attitudes toward energy development tend to be more negative during periods of intense development" and that "landowner compensation or experience with an energy company" is a "strong predictor" (p. 686) of attitudes.

This study cannot confirm or disconfirm any of the public health literature because no public health information was ascertained during the interviews. EPA's study of hydraulic fracturing and the potential impact on drinking water resources has not yet been released for public comment and peer review (EPA, 2014). It is very likely that EPA may influence public perceptions of the positive and negative social consequences associated with drilling and hydraulic fracturing based upon the findings in the published report.

Rahm and Riha (2011) studied public policy alternatives which support a strategic management approach combining regional water resources management; they recommend regional planning along with project-level environmental oversight. This study confirms their findings, supporting some county level planning. However, the stakeholders in the study preferred autonomy in matters of zoning and other public policy issues having to do with managing social consequences pursuant to the phenomenon. Therefore, the results are likely mixed, and further study would be required on specific issues to confirm or disconfirm findings. Presently, water and energy resources continue to be managed independently.

Scott et al. (2011) incorporated energy development and water resources public policy; those findings were confirmed by this study. Decision-making continues at the most fundamental level, individual communities (municipalities/localities), which operate autonomously. While some planning and networking occurs among them, and with the county, these stakeholders prefer to develop public policy independently, at the local level. Bazilian et al. (2011) incorporated a third variable, food, to Scott et al.'s theory, suggesting improved resources planning could be achieved. This study did not confirm nor disconfirm the results of that study as the third variable was not incorporated into this study.

Disjointed regulatory structures and frameworks is another variable that has been studied in the literature. Rahm (2011) examined the lack of a cohesive regulatory framework in Texas for unconventional energy development, suggesting that fragmented policy at all levels of government undermines holistic resources planning and management. Without a cohesive policy, a state or local culture will be the primary impetus controlling the future of unconventional energy development. This study confirms Rahm's findings. The political, social, and local culture of the counties and the individual municipalities are dictating public policy related to managing social consequences of the phenomenon.

Blohm et al. (2012) focused on disjointed public policy and recoverable gas estimates, has relevance to this study in so far as it relates to public policy variability. This study confirms that there is a fundamental lack of consistency among municipalities and counties with respect to public policy, as found in Blohm et al. However, this study

found that the disparities appear to be by choice—individual municipalities prefer the autonomy to make their own decisions with respect to zoning and policy development to manage social consequence issues.

Kinnaman's (2011) research on the positive economic impacts could not be positively confirmed nor disconfirmed by this study. Advanced econometric modeling was not performed as part of this analysis. Likewise, Weber's (2011) comparative analysis of 338 counties in Texas, Wyoming, and Colorado could not be confirmed or disconfirmed by this study. Luzadis et al.'s (2010) ecological economic study also could also not be confirmed or disconfirmed by this study. Although positive economic social consequences were part of the findings of this study, an advanced economic analysis was beyond the scope of the study.

Robinson's (n.d.) theory of ecological economics may represent a suitable framework for exploring unconventional energy development in the Marcellus shale. This political theory posits that ecological economics fails to adequately incorporate democratic principles, that unfettered economic growth and sustainability may not be congruous, and that restorative justice may be an appropriate means of ascribing responsibility to the populace for the decisions it makes. It is unclear whether or not this study confirms Robinson's theory. The study counties realized economic growth, but also believe they have experienced sustainable growth; where the energy companies have done damage (to infrastructure, for example), they have made reparations; tax advantages have extended to all residents regardless of whether or not they have drilling on their properties. However, key informants also reported unethical practices by energy

companies taking advantage of homeowners, citizens taking advantage of energy companies in housing/rental property leases, and other instances where reparations were not/could not be fully made. In addition, although the belief is that the economic growth is sustainable, it is unclear at the present time whether or not this is accurate. Ecological economics may be a suitable theory for unconventional energy development, but this study can neither confirm nor disconfirm Robinson's theory. A more focused study would be required to determine the appropriateness of ecological economics as a suitable framework for unconventional energy development in the Marcellus shale.

Hughes (2012) linked concepts of justice to climate governance, and identified four mechanisms of injustice, including: political economy of poverty, thick injustice, technocratic governance, and institutional capacities (p. 3-4). This study can neither confirm nor disconfirm Hughes's findings; a more in-depth study of the deep-rooted local political and socio-economic structures in the communities would be required to enhance understanding of the injustices that may affect public policy development in the subject counties.

Recent publications have explored social perceptions of risk, residents' attitudes of the phenomenon, and public policy development. Brasier et al. (2013) found that individual risk assessment is a highly complex endeavor and that apprehension about whether or not the energy industry will operate safely competes with economic opportunity and fear about adverse environmental impacts, among other factors (p. 14). Brasier et al. (2013) noted that in the early boomtown stage, problems and perceived unethical practices by the energy companies associated with leases contributed to

undermining trust in the community; but that “participatory processes” and “constructive dialogue” can build trust with time among interested parties. This research confirms their findings, and supports these recommendations for participatory dialogue, particularly in the early stages of the phenomenon.

In addition, Schafft, Borlu, and Glenna (2013) studied the relationship between local perceptions of risk and opportunity through the lens of school districts in Pennsylvania’s Marcellus shale region. Regarding boomtown theory, they recommended that drilling extent is their most important scholarly contribution to the theory, variability with time, intra-regionally (with local development), and therefore had differential community effects. This study confirms their findings of variability with time, and supports their use of boomtown theory as partially appropriate for this phenomenon.

Another recent publication related to resident views was a longitudinal study (2009-2012) in Pennsylvania completed by Willits, Luloff and Theodori (2013). The most significant finding from their study was that more respondents appeared to have enough knowledge gained during that short period of time to answer the survey questions than they had during the previous survey. In both the 2009 and 2012 surveys, support for drilling was larger than opposition; 2012 respondents indicated larger opposition to drilling and respondents in 2012 were more concerned about environmental issues than were the 2009 respondents. The attitudes reflected during this study disconfirm Willits et al.’s (2013) study in terms of environmental concerns.

Finally, Heuer and Lee (2014) examined stakeholder attitudes in the Susquehanna River basin in Pennsylvania across stakeholder sectors, nonprofit, government, and

private, on four categories, economic opportunity, health and safety, preserving communities, and achieving energy security (p.1). Their study found that public concern ranked, in order: health and safety, communities, economic opportunity, and energy security (p. 15). On the surface, this study seemed to disconfirm Heuer and Lee's (2014) findings; however, if the research question is about public concern, I would submit that residents in Susquehanna would be less concerned about economic opportunity, as they have already come to realize economic benefits. It is reasonable to expect they would be concerned about health and safety presently because the long term effects of drilling and hydraulic fracturing are unknown at this point in the boomtown cycle.

Theoretical and Conceptual Frameworks

A contemporary theoretical framework has not been widely accepted for understanding the 21st century social consequences associated with this phenomenon, although boomtown theory has been developed in the most recent social science literature (Brasier et al., 2011; Brasier et al., 2013; Heuer & Lee, 2014; Wynveen, 2011). The social disruption element of boomtown theory is something reported by all key informants in this study. The typical boomtown phases of social disruption are: enthusiasm, uncertainty, panic, and adaptation. From the interviews performed in this study, respondents reported that there was apprehension, followed by uncertainty (education), and then the community struggling with negative social consequences during the construction/drilling stage (9-12 months)—adaptation, and finally consensus as they began to realize the positive social consequences. The characteristics of the existing boomtown phases did not accurately depict the contemporary social phases of disruption

reported in this study because the key informants had access to information resources. It is reasonable that comparable localities will have similar access to information resources, and that more contemporary boomtown phases should be developed reflective of this modern reality.

Limitations of the Study

Because a case study is intended to explore a specific case (or cases) to attain a contextually rich understanding about a phenomenon, as opposed to facilitating broad generalizations, this study has particular application to a certain sets of similar circumstances (Brower, Abolafia, & Carr, 2000, p. 371). It is therefore incumbent upon the reader to determine the relevance of the findings to a particular locality, municipality, county, or other jurisdiction, geographic location, or geologic setting having similar, relevant parameters.

For this phenomenon, the unique characteristics of Marcellus shale communities and the exploratory nature of inquiry supported the selection of a qualitative case study method. The study identified similarities and differences in the experiences of the sample localities (embedded subunits), which led to a larger understanding of the phenomenon, overall, and with other cases in the literature.

Respondent bias was qualified at the onset of key informant interviews, and trustworthiness was ensured throughout by accurate conveyance of decision-maker experiences and perceptions representative of the unit of analysis (the community). Researcher bias was also clarified, and all reasonable measures were employed

throughout the research process to ensure the highest standards of ethical and trustworthy data collection, analysis, and reporting were performed.

Recommendations

The purpose of this study was to explore the positive and negative social consequences of unconventional energy development in the Marcellus shale, specifically, because the phenomenon is comparably new to the Appalachian basin as compared to the Barnett shale in Texas. In order to construct a contemporary boomtown theory for unconventional energy development, such comparative analyses are further suggested. Two of the variables tied to location may be the concepts of “identity,” and extraction history (if applicable). These themes emerged as significant from this study. How is boomtown theory tied to each? How identity and extraction history variables influence boomtown phases may be influential to the creation of a contemporary boomtown theory, and future research could explore and compare them to determine their relevance.

Implications

The implications of this study for positive social change at the societal level have to do directly with the research question, leveraging positive and mitigating negative social consequences. When a new community knows that unconventional energy development is imminent, this marks the precursor to the beginning of the boomtown phases.

What the key informants in Bradford, Susquehanna, and Washington Counties did was travel and collected as much information as they could from other localities that had already experienced the phenomenon. This is reasonable if time and resources are

available, but it is not always feasible. The information can be readily available through collaborative partnerships among jurisdictions and energy companies in advance.

Along with information and education, equipment and policy resources can be pre-positioned and updated. At a minimum, some of the following issues can be considered: housing, roads, traffic, congestion, the needs of school systems for children of temporary workers, edification of landowners as to leases, drilling/planning logistical challenges of the “ramp-up stage” which will likely last from 9-12 months. Planning and zoning issues will need to be addressed through local ordinances (if they are not already) and will need to cover appropriate nuisance issues (noise, lights, etc.). Local workers can be trained in advance of the industry to leverage employment opportunities that will be available when the industry does arrive. Partnerships between the energy industry and local community colleges can be created in support of training and education. Public safety personnel can be trained in advance so they are prepared for emergency response scenarios; GIS systems can be updated; 911 and other emergency management systems and plans can be updated, as necessary.

The implications of these changes can create employment opportunities for students and youth in the area; enable generational stability; enhance existing business and create new business; support public safety; ensure adequate housing for new workers; protect homeowners through education (leases); improve planning and zoning through logistical communication with energy companies; create the need for less transient workers as locals workers will be prepared to work in the industry.

These efforts require open communication between leaders at the county/local levels and industry, and facilitate strategic planning on both sides. It will require a liaison or planning representative from the county and from the energy company working together, depending upon government structure, well in advance of construction.

Conclusion

Unconventional energy development in the Marcellus shale promises vast amounts of natural gas, but at what cost? The costs are often unseen, as is the resource itself. This study explored the positive and negative social consequences of unconventional energy development. Residents in Bradford, Washington, and Susquehanna County Pennsylvania have been seeing the positive consequences, a new hospital in Susquehanna County, new libraries, lower taxes, new hotels and businesses; and they have adapted to the negatives. Leveraging positive social consequences and mitigating negative ones can be advanced by planning sustainably and strategically, being adaptable and employing public policy tools in collaborative partnerships with stakeholders and energy companies.

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Appendix A: Email to Research Participants

Dear Participant:

Thank you very much for your time on _____(date) to discuss my dissertation research and to consider participation in the study. As I mentioned, this research is intended to explore the experiences of localities regarding the positive and negative social consequences of unconventional energy development, and the role of stakeholders and resources needs pursuant to decision-making of Marcellus shale communities. Your participation in this study, as a key informant knowledgeable about the history of horizontal drilling and hydraulic fracturing in your area, will help to create a better understanding of this phenomenon. In so doing, the intent of this study is to assist other localities as they deal with the challenges of mitigating negative social consequences and leveraging positive ones, working with stakeholders, and using resources effectively. I sincerely appreciate your willingness to share your experience and expertise!

Attached to this email are two forms: a Consent Form that describes the study purpose, procedures, the interview questions, contacts/questions, with signature line for your participation assent, and a Confidentiality Agreement (signed by me) assuring that any and all information you share will be held in the strictest confidentiality. If you would, please, sign and return the Consent Form at your earliest convenience—upon receipt of this form, I will contact you to schedule the research interview.

Thank you very much for agreeing to participate in this very interesting and valuable research!

M.K. Gorman, MDS, Dissertation Student, Walden University

Appendix B: Informed Consent Letter Attachment

CONSENT FORM

You are invited to take part in a research study of the local decision-making experience of horizontal drilling and hydraulic fracturing in the Marcellus. Study participants include key informants from several localities in Pennsylvania who have direct knowledge and experience of decision-making surrounding this phenomenon (drilling and hydraulic fracturing). This form is part of a process called “informed consent” to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Mary Kathleen “MK” Gorman, a doctoral student at Walden University and a professor at Embry-Riddle Aeronautical University.

Background:

The purpose of this study is to explore the positive and negative social consequences of horizontal drilling and hydraulic fracturing in the Marcellus shale, including how stakeholders and resources influenced public policy development.

Procedures:

If you agree to be in this study, you will be asked to schedule a one-time interview (at the location of your choosing) which will require approximately one hour of your time. In addition, you will be asked to provide follow-up verification of the researcher’s interpretation of your interview responses (by email or telephone).

Interview Questions:

During the face-to-face interview, you will be asked the following questions:

1. How has horizontal drilling and hydraulic fracturing affected this community? (The following prompts may be used consistent with the case study by Anderson & Theodori, 2009):
 - a) What local-level benefits have occurred because of increased energy development?
 - b) What perceived negative impacts have accompanied increased development?
 - c) Do you feel the benefits of development have outweighed the costs? How and why?
2. How have the community’s stakeholders influenced decision-making and public policy development in this locality?
3. What resources needs do you think are important for decision-making associated with the phenomenon?

You will also be asked to describe your role and responsibilities in the organization (tenure, job duties), length of residence in locality, whether or not you are personally involved in horizontal drilling/hydraulic fracturing, and whether you have family or friends who are directly involved or affected. These questions are used to establish your unique context, experience, and how you come to possess knowledge of the phenomenon.

Voluntary Nature of the Study:

This study is voluntary. Everyone will respect your decision to agree or decline participation in the study. If you decide to join the study now, you can still change your mind later. You may stop at any time without penalty.

Risks and Benefits of Being in the Study:

Being in this type of study involves some perceived risks that may be associated with one's employment; the complete confidentiality of this study is assured. Being in this study would not pose a risk to your safety or wellbeing, personally or professionally. The benefits of participation include the professional contribution you can make to assist other localities as they face challenges associated with the phenomenon, in the Marcellus shale, in other unconventional shale plays, and on a global scale. Your expertise and experience is crucial to creating a better understanding of the positive and negative social consequences, how to involve key stakeholders, and the resources localities can use to assist in important decision-making.

Payment:

There will be no payment or other inducements associated with your participation in this study. A thank you gift, however, will accompany your copy of the study's findings.

Privacy:

Any information you provide will be kept confidential. The researcher will not use your personal information for any purposes outside of this research project. Also, the researcher will not include your name or any other identifying information that could identify you, individually, in the study reports. Data will be coded numerically, kept in a password-protected electronic database at the researcher's home, and kept for a period of 5 years (as required by Walden University).

Contacts and Questions:

You may ask any questions you have now; or if you have questions later, you may contact the researcher via telephone (██████████) or email. If you wish to talk privately about your rights as a research participant, you may call Dr. Leilani Endicott (612.312.1210), Walden University's representative who is happy to discuss this with you. Please reference Walden University's approval number for this study, which is: _____ and expires on _____.

Please retain a copy of this signed form, and return a copy to me by email at:

██████████.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By signing below, I understand that I am agreeing to the terms described herein.

Printed Name of Participant:

Date of Consent:

Participant Signature:

Researcher Signature:

Appendix C: Confidentiality Agreement

Name of Signer: **Mary Kathleen Gorman**

During the course of my activity in collecting data for this research: “The positive and negative social consequences associated with horizontal drilling and hydraulic fracturing in the Marcellus shale” I will have access to information, which is confidential and should not be disclosed. I acknowledge that the information must remain confidential, and that improper disclosure of confidential information can be damaging to the participant.

By signing this Confidentiality Agreement I acknowledge and agree that:

1. I will not disclose or discuss any confidential information with others, including friends or family.
2. I will not in any way divulge copy, release, sell, loan, alter or destroy any confidential information except as properly authorized.
3. I will not discuss confidential information where others can overhear the conversation. I understand that it is not acceptable to discuss confidential information even if the participant’s name is not used.
4. I will not make any unauthorized transmissions, inquiries, modification or purging of confidential information.
5. I agree that my obligations under this agreement will continue after termination of the job that I will perform.
6. I understand that violation of this agreement will have legal implications.
7. I will only access or use systems or devices I’m officially authorized to access and I will not demonstrate the operation or function of systems or devices to unauthorized individuals.

Signing this document, I acknowledge that I have read the agreement and I agree to comply with all the terms and conditions stated above.

Signature:

Date:

Appendix D: Interview Protocol

Introduction:

Thank you for agreeing to participate in this study, I sincerely appreciate it. As you know, this research is for completion of my dissertation at Walden University; I also hope to publish the results in a professional journal so they can be shared with potentially interested localities and other stakeholders interested in this phenomenon in the Marcellus shale.

Just to summarize where we are:

- you have signed and returned the Informed Consent letter;
- I have provided the Confidentiality Agreement to you. There will be no reasonable way your identity can be correlated with your interview transcript by anyone other than me. Your identity will a “number” coded to your name stored in a separate, password-protected electronic location. I will keep all study materials for a period of 5 years;
- you have the option to withdraw your participation at any time without adverse consequences to you;
- you have not received any inducements or payment for your participation in the study;
- and upon completion of the study, I will provide you with a summary of the research findings. It is my hope that the findings from this research can be used by other localities facing similar challenges to the ones you experienced when drilling and hydraulic fracturing began and evolved in your community. In essence, your knowledge and experience will help other communities mitigate negative social consequences and

leverage positive consequences, work with key stakeholders, and effectively manage resources.

For the purposes of ensuring trustworthiness, this interview will be audio recorded. Do you have any questions up to this point?

Interview

This case study is intended to explore the experience of Marcellus shale localities with the phenomenon horizontal drilling and hydraulic fracturing at the local level. Although there are a series of 5 specific questions I emailed to you before this interview, please feel free to share any and all information you think is important relative to the study. The questions, themselves, are not intended to constrain anything you wish to share in this interview related to the locality's experience with this phenomenon.

The first 3 questions were selected because they are consistent with similar studies of the phenomenon in the Barnett shale; your experience with the social consequences may or may not be similar, that's something we hope to find out. The last 2 questions were developed by me because they are meaningful for other localities in planning and decision-making. They are intended to help characterize your community's unique relationships with the people and resources that have been important to consider in decision-making and public policy development.

First let's establish a context for you, as a key informant:

Name, length of service in work capacity, specific job duties/decision-making responsibilities related to the phenomenon, length of residence in locality, a description

of your personal role in relation to the phenomenon. Do you feel you have any bias for or against the phenomenon? Can you describe why you feel that way?

Now we will proceed to the interview questions I emailed to you earlier:

1. How has horizontal drilling and hydraulic fracturing affected this community?

(The following prompts may be used consistent with the case study by Anderson & Theodori, 2009):

- a) What local-level benefits have occurred because of increased energy development?
 - b) What perceived negative impacts have accompanied increased development?
 - c) Do you feel the benefits of development have outweighed the costs? How and why?
2. How have the community's stakeholders influenced decision-making and public policy development in this locality?
 3. What resources needs do you think are important for decision-making associated with the phenomenon?

At this time, I would like to ask you if there is anything you think is important to understanding your experience with the phenomenon that we have not yet discussed?

Conclusion:

I very much appreciate your taking the time to meet with me today to discuss your locality's particular experience with drilling and hydraulic fracturing here. Your unique

perspective will help other communities and professionals, like yourself, facing the social consequences and challenges of drilling and hydraulic fracturing.

As I mentioned previously, your interview responses will be kept completely confidential and you may withdraw from the study at any time. I will be sending you a summary of the key themes which emerged from this interview so that you can clarify your responses if I have misinterpreted them. I also appreciate your willingness to answer any follow-up questions which may arise as I begin data analysis. Upon completion of the research, I will send you a summary of the findings. Thank you very much for your participation.

Appendix E: Contact Summary Form

Contact Type: _____Face-to-Face Interview _____Telephone Call

Locality:_____

Interview Site:_____

Contact Date:_____

Today's Date:_____

Key Informant ID:_____

Role:_____

Background Information/Context:**Question/Answer Summary of Responses:**Questions:Response Information:

1. Experience

2. Benefits

3. Negative Impacts

4. Benefits Outweigh Costs

5. Stakeholders

6. Resources

Emergent Themes and Central Issues:

Salient Observations with this Contact:

Potential Relationships:

Questions for Follow-up? Clarification? Ideas for Further Study?

Curriculum Vitae

MARY KATHLEEN “M.K.” GORMAN, M.D.S.
**Education:**

PhD—Policy Analysis & Administration Public Safety Management (GPA 4.0) expected 2014
 Walden University, Minneapolis, MN
 Dissertation Topic: Social Consequences of Horizontal Drilling and Hydraulic Fracturing in the Marcellus Shale

Master of Science—Disaster Science (GPA 4.0)
 University of Richmond, Richmond, VA 2009
 Master’s Thesis: The 9/11 Victim Compensation Fund: A Case Study
 Honors: The Disaster Science Book Award

Bachelor of Science—Geology (Minor, English) (GPA 2.72)
 College of William and Mary, Williamsburg, VA 1985
 Thesis: Groundwater Quality at the Chesterfield County Landfill, Chester, VA

Professional Certifications and Memberships:

OSHA Certified 40 Hour Health and Safety
 National Institute of Health Office of Extramural Research Certification
 Certified Emergency Manager (expected 2015)
 International Association of Emergency Managers
 American Society for Public Administrators
 Mid-Atlantic Region of Environmental Professionals Member
 Emergency Management Coordinator (Greater Staffordshire Civic Association)

Relevant Professional Experience:

Assistant Professor, Associate Department Chair **September, 2012-Present**
Associate Discipline Chair
Embry-Riddle Aeronautical University

Full-time Assistant Professor in the Security and Emergency Response Department responsible for program marketing, enrollment management, articulation agreements, transcript evaluation and equivalency determinations, program assessments, scheduling, oversight of adjunct faculty, course development, and other administrative duties as required. Program Chair for 3 Master of Science Degree Programs including Master of Science in Cybersecurity Policy and Management, Master of Science in Human Security and Resilience, Master of Science in Security and Intelligence Studies. Instructor for both Security and Emergency Response and Department of Aeronautics Safety undergraduate courses online. Developed course learning outcomes, program outcomes, and alignments in accordance with SACS and internal assessment criteria and

procedures. Elected to Faculty Senate 2013. Liaison for ERAU-Dallas/Ft. Worth Fire Training Research Center Partnership, and serving on Aircraft Rescue & Fire Fighting Professional Designation Review Board. Selected by the Executive Board of the Virginia for Women in Higher Education for the 2013-2014 Virginia Network Senior Women's Leadership Seminar (ACE). Serving on the National Fire Academy Committee for Professional Development of Aircraft Rescue and Fire Fighting Education.

Adjunct Faculty **2010-**
September, 2012
Embry-Riddle Aeronautical University

Professor for course SFTY 315 Environmental Compliance and Safety. A foundational course in the health and safety curriculum designed to provide knowledge of environmental law, emergency management, hazardous materials response, hazardous waste management, and best practices in industry and government. Major statutes, regulations, policy, executive orders, and the functions of government and the private sector pursuant to NIMS, environmental compliance, and public health and safety are covered. Teaching evaluations from ERAU Quality Management and students have been outstanding. Because this was an "old template" course, I was responsible for developing and implementing all aspects of course management on Blackboard; innovations included a two-tier approach to discussion board for each student to contextualize weekly learning objectives using contemporary incidents citing current policy dynamics.

Senior Project Geologist, Virginia Branch Office Manager **1994-**
September, 2012
Bennett & Williams, Inc., Richmond, VA

Responsible for technical design, implementation, data analysis, and project management for over 300 emergency response, contamination, and remediation sites across the Commonwealth of Virginia and Maryland, including 24-hour emergency response for oil spills, chemical releases, hazardous materials, hazardous waste, and solid waste projects. Developed and presented for approval the City of Richmond Metropolitan Medical Response System (MMRS) Strategic Plan (2011-2012). Drafted emergency operations and response plans and business continuity plans to mitigate immediate risks to human health and the environment for private clients. Excellent working relationship with federal, state, and local leaders, regulatory agencies, private sector partners, and stakeholders in environmental and emergency management disciplines. Performed more than 25 Quantitative Risk Assessments; HAZUS-MH software and ArcInfo GIS; certified in Virginia court system as an expert witness.

Environmental Program Planner **1985-1994**
Virginia Department of Environmental Quality, Richmond, VA

Virginia Department of Environmental Quality State-Lead and Alternate Water Supply Program Coordinator responsible for program implementation, personnel supervision and training, contract administration, fiscal and grant management, community interaction, statewide project prioritization. Participated in program development from inception, including drafting of state statute, regulations, policies, technical guidance documents/manuals, and training programs for state-wide staff. Served on 24-hour Pollution Emergency Response Team (8 years): fish kills, tire

fires, vapor abatement, hazardous waste management, and catastrophic releases of hazardous and non-hazardous materials. Project manager for EPA federal grants of \$600k, \$800k, \$1m, \$1.5m, and \$2.0m (Leaking Underground Storage Tank Program). Supervised \$500k and \$1m Operation and Maintenance Program annual contracts for the Alternate Water Supply Program. Project manager for a \$14m Basic Ordering Agreement contract supervising 10 subcontractor consulting firms. Fiscal responsibilities included annual program planning for fund allocation, preparation and maintenance of EPA grant line-item budgets, management and approval of all grant expenditures in compliance with federal grant requirements. Certified as an expert witness in Virginia court system

Research Interests:

The nexus of environmental issues and emergency management, strategic planning, disaster preparedness and response, Marcellus shale horizontal drilling and hydraulic fracturing, unconventional energy development, water resources management, risk assessment, aircraft rescue and firefighting, research methods and design (quantitative, qualitative, and mixed-methods).

Publications and Presentations:

Herron, R.I. & Gorman, M.K. (2014, October). *Assessing the Use of Interactive Technology with Aircraft Fire Fighting Training (ARFF)*. Paper presented at the annual meeting of the 25th ARFF Working Group International Conference, Galveston, TX.

Herron, R. & Gorman, M.K. (2014, September/October) Promoting Safety Through Research. *Aircraft Rescue Fire Fighting Working Group News*, 25 (5), 14-15.

National Fire Protection Association (NFPA) National Conference (June, 2014)
Technology to Augment ARFF Training (co-presenter).

Gorman, M.K, Graber, J., Russell, E., Whitaker, D., (2014, June). Aircraft Rescue Fire Fighting Professional Development-How Important Is it? Paper presented at the annual conference of Fire and Emergency Services Higher Education in Emmitsburg, MD.

AIR(3) Conference—Assessing the Impact of Interactive Technology on Aircraft Rescue and Fire Fighting Training (January, 2014) (co-presenter).

ARFF (Aircraft Rescue & Fire Fighting) Chief's & Leadership School National Conference –Academics and ARFF (February, 2013).

Gorman, M.K., Herron, R. I. (2013). Research is a Partner in Forward Focused Time. *Carolina Fire Rescue EMS Journal* 28(1); 27.

Gorman, M.K. (2012). Academics and ARFF. *ARFF Working Group News* 23(6), 22.

City of Richmond (2012). *Metropolitan Medical Response System MMRS Strategic Plan*. Richmond, VA: City of Richmond Office of Emergency Management.

Gorman, M.K. (2009). *The 9/11 Victim Compensation Fund: A Case Study*. M.S. University of Richmond School of Continuing Studies, 2009. Richmond: UMI, 2009. Print.

Commonwealth of Virginia. (1990). *Department of Environmental Quality Underground Storage Tank Technical Procedures and Guidance Manual*. Richmond, VA: Department of Environmental Quality.

Commonwealth of Virginia. (1989). *Underground Storage Tank Technical Regulations Section VI Release Response and Corrective Action*. Richmond, VA: Department of Environmental Quality.

Gorman, M.K.. "Groundwater Quality at the Chesterfield County Landfill, Chester, Virginia." (Unpublished Thesis, College of William & Mary, 1985).

Research Activities and Selected Papers:

Walden University, PhD Policy Analysis and Administration—Public Safety Management

- Dissertation Proposal completed (6/01/13)
- Annotated Bibliography & Research Design for Marcellus Shale Research (2012)
- Five Qualitative Research Approaches and the Role of Theory (2012)
- The Nexus of Emergency Management and the Environmental Sector in Virginia (2011)
- Quantitative Research Design Using SPSS Software: Disaster Mitigation and the Economic Value of Environmental Resources (2011)
- An Analysis of Qualitative, Quantitative, and Mixed-Methods Research Designs (2011)
- Emergency Management Theory (2011)
- An Ethical Decision-Making Model Application (2010)
- Literature Review on Climate Change Ethics (2010)
- Vertical Government Financial Structure (2010)
- Radiological Emergency Preparedness in Virginia (2010)
- SWOT Analysis—Virginia Department of Emergency Management (2010)
- Financial Assessment of the Virginia Department of Emergency Management (2010)
- Technological Financial Management Tools in Virginia (2010)

Capella University, PhD Public Safety—Emergency Management (2009-2010)

- Potential Implications of Posse Comitatus for Emergency Management (2009)
- The Theoretical Progression of Leadership Research (2010)
- Ernesto—a NIMS Success in Virginia (2010)

- Hurricane Katrina: A Crisis of Leadership and System (2010)
- NIMS Implementation and Best Practices from the 2007 Greensburg, Kansas Tornado (2010)
- Risk Mitigation Challenges and Leadership (2010)
- Theoretical Approaches to Transformational Change (2010)
- Contemporary Public Health Challenges and Ethics (2010)
- NIMS Core Components, Skills and Technology (2010)
- NIMS Relevance Given Contemporary Threats (2010)

University of Richmond, Master of Disaster Science (2006-2009)

- Three Mile Island—Disaster Mythology and Social Dimensions (2006) (Presented to the Capital Region Commission)
- Radiation and Chemical Contaminating Terrorism: A Multi-Disciplinary Challenge (2007)
- Pandemic Flu Planning and Immunization: Legal Issues in a Dynamic Process (2007)
- Alternative Renewable and Sustainable Energy—The Emerging Paradigm? (2007)
- The Legal Implications of Government Watchlists (2007)
- The DHS National Response Framework: A Missed Research Opportunity (2008)
- Columbine to Blacksburg (2008) (Contributing Author)
- A Research Design Addressing Persons with Life-Saving Medical Equipment, City of Richmond, Virginia, Fourth District—Present and Future (2008)
- Remote Sensing and Hazard Analysis (2008)
- Climate Change Implications for Counties near the Lower Chesapeake Bay (ArcGIS Maps produced using ArcMap 9.2) (2008)
- The 9/11 Victim Compensation Fund: A Problematic Precedent (2008)

References available upon Request