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A THEMATIC ANALYSIS OF LOCAL RESPONDENTS' PERCEPTIONS OF BARNETT SHALE ENERGY DEVELOPMENT*

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ABSTRACT

Researchers have found that the economic, social, and environmental impacts of energy development vary with both the type and location of development. Previous studies have highlighted impacts associated with the conventional energy development that occurred in the western United States in the 1970s and 1980s, and with offshore oil drilling in the Gulf of Mexico. Recently, however, unconventional natural gas development has become a more common type of energy development, the impacts of which are not yet well understood. To assess these impacts, as part of a larger quantitative study conducted within two Texas counties, survey respondents were invited to share “additional comments” as desired. I analyzed these comments using open coding and constant comparison to identify prominent themes for each county. Themes ranged from positive to negative, and reflected economic, social, and environmental impacts accompanying unconventional natural gas development. Findings may inform theory and be of interest to community leaders and others interested in the impacts of unconventional gas development.

The Barnett Shale region of north-central Texas is one of the largest unconventional natural gas reservoirs in the United States. Developers extract the natural gas resources through relatively new, but increasingly popular, technical processes that may potentially avoid many adverse effects of previous energy development efforts (e.g., rapid population growth). Despite the ability to develop unconventional natural gas resources in the absence of rapid population growth, however, the need for a thorough assessment of the industry’s economic, social, and environmental impacts, both positive and negative, remains.

Previous research has highlighted the community-level impacts of various types of energy development, including conventional energy development in the western energy boomtowns of the 1970s and 1980s, as well as offshore oil drilling in the Gulf of Mexico. Unconventional energy development in the Barnett Shale represents yet another type of energy development, occurring within yet another local context. Due to contextual differences, its impacts cannot be assumed to mirror those associated with other forms of development. At present, our understanding of such potential impacts remains incomplete. Hence, in the present study, I sought to discover whether the range of impacts experienced by

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LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

9

communities within new natural gas plays aligns with boomtown literature, by identifying both the positive and negative impacts of unconventional energy development occurring within two Barnett Shale counties, as conveyed in open-ended comments provided by respondents to a mail survey on the topic of unconventional natural gas development.

LITERATURE REVIEW

Western Energy Boomtowns

Boomtown literature over the past several decades has depicted a phenomenon wherein the discovery and extraction of natural resources have led to rapid development of those resources, and often to related impacts upon the typically rural areas where they have been discovered. Researchers have identified numerous economic, social, and environmental consequences – both positive and negative – associated with boomtown development. Some positive economic impacts have included increased economic activity overall, fiscal benefits for some sectors of the local population, improvements in local entertainment and recreational services, and potential employment opportunities (Freudenburg 1982; Lillydahl et al. 1982). Increased cost of living, on the other hand, has been a major negative economic impact (Little 1977). Social impacts have been predominantly negative, and have included heightened crime rates, housing and infrastructural shortages, and individual well-being problems such as stress, substance abuse, and depression (Albrecht 1978; Freudenburg 1982; Lillydahl et al. 1982; Little 1977; Lovejoy 1977). Environmental impacts of boomtown development have included aesthetic degradation, loss of access to the outdoors, limitations to alternative land uses (Albrecht 1978), degradation of air quality (Lovejoy 1977), and loss of wildlife habitat (Freudenburg and Gramling 1992).

Researchers have attributed the impacts enumerated above to the rapid population growth that often accompanies energy development, rather than to the resource development itself (Brookshire and D'Arge 1980; Cortese and Jones 1977; Gartrell, Krahn, and Trytten 1984; Gilmore 1976). The literature, in fact, posits that rapid population growth is a *primary* defining characteristic of a boomtown (Gramling and Freudenburg 1990; Little 1977). Indeed, research on the impacts of energy development occurring in less rural areas under different circumstances has supported that assertion (Forsyth, Luthra, and Bankston 2007; Gramling and Brabant 1986; Gramling and Freudenburg 1990).

Offshore Oil Production

Researchers studying offshore oil drilling communities have discovered differing impacts from those found in conventional drilling communities, largely due to contextual differences between the sites and types of energy development (Forsyth et al. 2007; Gramling and Brabant 1986; Gramling and Freudenburg 1990). First, by definition, offshore drilling occurs outside, rather than directly within the adjacent community. That is, it takes place offshore, often in the Gulf of Mexico. The scheduling of work also facilitates commuting among workers, whereby they need not live in the adjacent community. Furthermore, the Gulf Coast communities nearest to drilling operations have typically been larger in population and more metropolitan than the small rural towns where conventional energy development takes place. As a result, these communities have not experienced the rapid population growth that Little (1977) noted as a prerequisite for boomtown status.

For example, Gramling and Freudenburg (1990) reported that Lafayette, Louisiana did not experience traditional boomtown impacts from offshore energy production because its initial population was larger than in most boomtowns and therefore did not grow by great percentages with the development of the drilling industry. Gramling and Brabant (1986) confirmed, through a study of two offshore energy production communities (both metropolitan in nature), that offshore drilling generally does not lead to typical boomtown impacts because associated population growth is neither rapid nor proportionally equivalent to that of traditional boomtowns. Thus, Forsyth et al. (2007) concluded that the boomtown social impact model may not be appropriate for offshore oil drilling.

Unconventional Natural Gas Development

Unconventional natural gas development is similar to offshore oil drilling in several respects. For example, as with offshore oil extraction, metropolitan counties are more conducive to natural gas extraction than to conventional resource development. This is largely due to technological advances, particularly in imaging and horizontal and directional drilling, through which the industry has drastically reduced the surface footprint of energy development activities (Durham 2006; Forbis 2001). The larger initial populations of metropolitan areas represent a larger local labor pool from which to draw industry workers. Furthermore, workers who do move into the area represent a much smaller proportion of the overall local population. Additionally, due to the short length of the drilling phase, approximately 65 days (Giraud 2006), temporary workers are not required to remain on-site for extended periods. Moreover, the production phase that follows

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

11

drilling requires even fewer workers. These factors combine to curb the population growth that often results in social and economic disruption in more rural environments experiencing rapid energy development.

Despite the ability to develop unconventional natural gas resources in the absence of rapid population growth, industry operations cannot be assumed to avoid all adverse impacts. For instance, the reduced surface footprint that allows for greater metropolitan energy development also allows for drilling closer to residential areas, leading to potentially conflicting interests among stakeholders (i.e., landowners, mineral rights owners, and other local residents who own neither). Besides residential drilling activities, this type of extraction requires hydraulic fracturing of wells, a process by which large quantities of freshwater (five to eight million gallons per fracturing procedure, according to David Burnett of the Global Petroleum Research Institute (March 2006)) are flushed into wells at extremely high pressures (along with propanol and other non-water agents) to create cracks, or fractures, in the shale that holds the natural gas. This process loosens the gas resources, allowing for their extraction (Durham 2006; Forbis 2001; Martineau 2003). However, where water resources are limited, or where rights to water are contested, conflicts may result.

The Barnett Shale, in north central Texas, is currently among the most productive natural gas reservoirs (or “plays” in the vernacular) in the United States (U.S. EIA 2011) and has thus attracted the attention of researchers interested in the economic, social, and environmental consequences of unconventional energy development. The shale is a geologic formation running parallel to the surface at a depth of 6,500 to 8,500 feet. The shale is 1,000 feet thick in some places, and as shallow as 30-50 feet thick in others. Industry operators have been using the imaging, drilling, and fracturing methods described above to extract natural gas from the shale since 1981, although drilling has become much more prolific over the past decade (Hayden and Pursell 2005).

In a recent study by Anderson and Theodori (2009), community leaders in two Barnett Shale counties identified both positive and negative impacts of this increased development. While acknowledging the economic benefits of the industry, study participants expressed concerns regarding public *health and safety*, environmental and water-related impacts of development, and quality of life issues. Because their study focused on community leaders specifically, the authors recommended that future research explore the perceptions of other stakeholder groups. Thus, the present research details the economic, social, and environmental

themes identified by household survey respondents in two Barnett Shale counties: Wise and Johnson (see Figure 1).

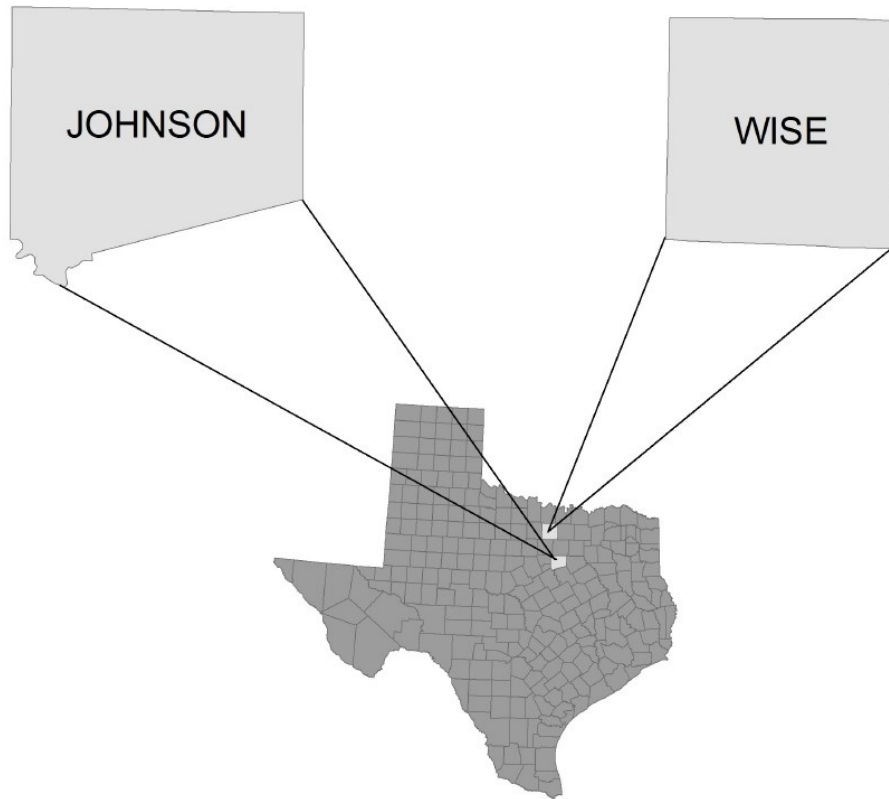


FIGURE 1. WISE AND JOHNSON COUNTIES IN RELATION TO THE STATE OF TEXAS.

METHODS

During the late spring and early summer of 2006, we administered a large-scale general population survey among a random sample of residents in Wise and Johnson Counties in north central Texas using a modified version of Dillman's (1978; 2007) total design method. Questionnaires were delivered via the United States Postal Service to 1,533 randomly selected households in the two counties (749 households in Johnson County; 784 households in Wise County). To obtain a representative sample of individuals within residences, we requested that the adult in the household with the most recent birthday fill out the survey, which was organized as a self-completion booklet. The survey contained 42 questions and required approximately 60 minutes to complete. After the initial survey mail out, a postcard reminder, and two follow-up survey mailings, we obtained a 39 percent

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

13

response rate. This resulted in 600 completed questionnaires across the two sites (301 questionnaires in Johnson County; 299 in Wise County).

Besides standard demographic items, the survey contained questions regarding respondents' experiences with, and perceptions of, the oil and gas industry; perceptions of the positive and negative impacts associated with local extraction activities; and personal interests in resource development (i.e., land and mineral rights ownership, employment within the gas industry, and so forth). At the conclusion of the survey, we invited respondents to share additional comments as desired. Of the 600 respondents who returned completed surveys, 66 provided additional comments (43 from Wise County; 23 from Johnson County).

Wise County respondents sharing additional comments had lived in the county for between ten months and 80 years, with a median length of residence of 21 years. Their ages ranged from 36 to 88 years old, and the median age was 55. The majority (86 percent) were white, and 47 percent were female. Fully 98 percent had completed high school or the equivalent, and 23 percent had earned a bachelor's degree or higher. Incomes varied greatly, with 12 percent earning less than \$30,000 annually and 21 percent earning \$90,000 or more annually. Homeowners comprised 98 percent of comment providers, whereas only 28 percent owned mineral rights.

Johnson County comment providers had lived in the county for between one and 55 years, with a median length of residence of 11 years. Ages ranged from 27 to 73 years old, with a median age of 48. All but two comment providers were white, and 61 percent were female. All who provided valid responses had completed high school or the equivalent, and 30 percent had earned a bachelor's degree or higher. Again, incomes varied greatly, with 17 percent earning less than \$30,000 each year, and 35 percent earning \$90,000 or more annually. Homeowners comprised 91 percent of comment providers, and nearly half (48 percent) owned mineral rights.

Table 1 shows a comparison of characteristics between the respondents providing additional comments and the overall survey sample. In addition, data from the U.S. Bureau of the Census (USBC) provide some bases for comparison of characteristics between the survey sample and the county populations (2010). For instance, minority responses were overrepresented by comparison with the overall survey sample and the population data. Specifically, populations are 91 and 90 percent white for Wise and Johnson Counties, respectively (USBC 2010), whereas the survey respondents for those counties were roughly 95 and 81 percent white. Those providing additional comments, however, were 86 and 78 percent white. In Wise County, females were underrepresented in the overall survey sample (37 percent) compared with census data (49.6 percent), but were well represented

among those providing additional comments (47 percent). In Johnson County, females were underrepresented in the overall survey sample (43.2 percent) compared with census data (50.1 percent), but were overrepresented in the group providing additional comments (61 percent).

TABLE 1. COMPARISON OF COMMENT PROVIDERS WITH SURVEY SAMPLE BY COUNTY

SELECTED CHARACTERISTICS	JOHNSON		WISE	
	PRESENT ANALYSIS	SURVEY SAMPLE	PRESENT ANALYSIS	SURVEY SAMPLE
Median length of residence (in years).	11	16	21	20
Range of length of residence (in years).	1-55	.5-80	.83-80	.83-80
Median age (in years).	48	55	55	57
Age range (in years).	27-73	20-93	36-88	25-93
Percent earning less than \$30,000.	17	20.4	12	18.1
Percent earning 90,000 or more.	35	23	21	25.5
Percent female.	61	43.2	47	37.0
Percent white.	78	81.4	86	95.4
Percent 25 years of age or older – high school graduate (or equivalent) or higher.	100	91.8	98	92.2
Percent 25 years of age or older – bachelor's degree or higher.	30	27.0	23	26.6
Percent who own their homes.	91	97.2	98	98.6
Percent who own mineral rights.	48	56.9	28	28.5

In both counties, survey respondents were better educated than the county populations. According to census data (2010), roughly three-quarters of each county's population has completed high school or an equivalent education. In contrast, nearly all of the respondents within the present analysis had reached this level of education (see Table 1). Likewise, whereas 13 and 13.8 percent of the Wise and Johnson County populations (respectively) had received a bachelor's degree or higher, roughly one-quarter of survey respondents in each county had received

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

15

bachelors' degrees (USBC 2010). Of respondents providing additional comments, 23 percent from Wise County and 30 percent from Johnson County had earned bachelors' degrees. The above comparisons show that, while the respondents within this analysis represent their respective populations in some respects, they also differ from the larger population in other respects. As a result, generalizability of the analysis and results presented here is limited.

Comments ranged in length from one sentence to over a page. They also displayed a great deal of passion, which resulted in rich textual data addressing a broad range of energy-related impacts. Because of the quantity, length, breadth, and fervor of these comments, they were well-suited to address the research question. I analyzed responses from each study county separately to identify similarities and differences between the two. I expected differences based on the purposive criteria used to select the counties. Namely, Wise County was chosen to represent a mature development site, where residents had been experiencing a greater intensity of gas development for a longer period than in Johnson County, which was being hailed as an emerging "sweet spot" (Hayden and Pursell 2005) for Barnett Shale development when this study was conceptualized. Thus, Johnson County was chosen to represent a site that was in the initial stages of large-scale energy development.

A colleague and I separately coded respondents' comments and sorted them into discrete elements that represented distinct ideas. Following the open coding of these comments, we used constant comparison to identify similarities and distinctions by comparing one segment of data (from the open coding) with another (Merriam 1998). Specifically, we each, individually, grouped the previously-identified ideas into categories of similar ideas and assigned each category a title consistent with the theme of the ideas reflected therein. After the coding process was completed, I conducted tests of Holsti's inter-rater reliability (Miles and Huberman 1994). The inter-rater reliabilities between the two coders for the themes identified from these data were 90 and 86 percent for Wise and Johnson Counties, respectively, indicating an acceptable level of reliability between coders (Miles and Huberman 1994). Also, as Merriam (1998) recommended, I sought feedback from a colleague knowledgeable about Barnett Shale energy development to ensure the validity of the themes identified.

ANALYSIS AND RESULTS

Numerous themes and subthemes emerged from the data, some of which overlapped between Wise and Johnson Counties, and others of which were unique

to one or the other (see Table 2). Themes fell broadly under three categories: economic, social, and environmental. I further elaborate upon each theme and subtheme below.

TABLE 2. THEMES IDENTIFIED WITHIN RESPONDENT COMMENTS.

SUSTAINABILITY		
DIMENSION	WISE COUNTY	JOHNSON COUNTY
Economic.	Industry economic benefits (10)	Industry economic benefits (4)
Social.	Distribution of revenue (5)	
	Justice & equity (16)	Citizen & stakeholder involvement (8)
Environmental. .	<ul style="list-style-type: none"> • Corporate responsibility • Trust • Regulation & legislation 	Quality of life & community identity (7)
	Quality of life & community identity (10)	<ul style="list-style-type: none"> • Aesthetic degradation • Community identity & character
	<ul style="list-style-type: none"> • Aesthetic degradation • Inconvenience 	Traffic & road conditions (6)
	Health & safety concerns (10)	Health & safety concerns (4)
	<ul style="list-style-type: none"> • Traffic accidents & fatalities • Gas well explosions • Health impacts 	<ul style="list-style-type: none"> • Traffic accidents & fatalities • Gas well explosions • Health impacts
	Power & politics (8)	
	Traffic & road conditions (7)	
	Environmental concerns (6)	
	Water issues (14)	
	<ul style="list-style-type: none"> • Water quantity • Water quality 	

NOTE: Numbers in parentheses indicate the number of comments comprising each theme.

Economic Themes

Economic benefits of industry development. Respondents in both Wise and Johnson Counties acknowledged the economic benefits experienced because of increased natural gas development in their communities. One Wise County respondent who had “been around long enough to have seen the impact on the State when oil

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

17

drilling stopped” noted a feeling of excitement at seeing the increase in gas development. Another mentioned the financial benefits of the industry for “hard working farmers and ranchers,” adding emphatically, “I think it is great!” Several comments referenced infrastructural improvements for county road bridges, volunteer fire departments, and local schools. The “money pumped into the Wise County economy by the oil and gas industry” was even called “our lifeblood.” Likewise, in Johnson County, respondents mentioned feeling “happy” about having leased their mineral rights, stating that “proceeds from gas wells are paying my property taxes” and that “residents need it [natural gas development]!”

Distribution of revenue. Wise County respondents noted one negative economic impact of energy development, namely, the unequal *distribution of revenue*. At the community level, one respondent expressed concerns that road repairs necessitated by industry activity, and funded by industry revenue, were disparately undertaken, neglecting certain areas and attending to others. Another stated that “I haven’t seen any direct improvements.” At a more individual level, respondents expressed that *industry economic benefits* favored mineral rights owners, gas companies, and their employees, calling these “the only benefactors of the natural gas industry in Wise County.” One respondent further asserted that “the people that own [the gas] can get rich off the underprivileged.” While *distribution of revenue* is identified as a theme within the economic category, it is clearly linked to the equity-related themes discussed below.

Social Themes

Quality of life and community identity. Respondents from both Wise and Johnson Counties offered comments relating to quality of life and/or community identity. Subthemes included *aesthetics* for both counties, *inconvenience* for Wise County, and *community identity and character* for Johnson County.

As for *aesthetics*, Wise County respondents referred to both gas wells and tanks as “ugly,” stating, for example, that they are “destroying property values and the scenery.” In a related comment, a respondent noted that “the beauty of several pieces of land in our community has been ruined.” Likewise, Johnson county respondents noted that “our area is littered with gas wells,” and that this “exploitation” of the land is “an eyesore.”

The inconvenience posed by energy industry operations emerged as a theme in Wise County specifically (although *one* respondent in Johnson County also made a supporting comment). Although the duration of the drilling phase for natural gas is relatively short, approximately 65 days (Giraud 2006), this phase is associated

with around-the-clock drilling, noise, and lights. Further, as previously mentioned, the relatively small surface footprint of unconventional gas development allows for drilling much closer to residential areas than drilling practices of the past. This was evidenced in responses to one of our quantitative survey items, which asked for respondents' level of agreement with the statement that gas production is occurring too close to residential areas. One respondent wrote in the margin that they agreed "110%." In relation to this close proximity, one respondent stated that the rights and needs of the gas industry often take priority over the needs of home and landowners, namely, that "they can work 24 hours a day, full volume, light that can't be shaded right outside bedroom windows, etc." Another added that destruction (e.g., of the landscape, the roads) caused by drilling equipment was an inconvenience. Finally, one respondent told of some friends who had a "rig put on their property, which has disrupted their quality of life." Clearly, then, inconvenience is one negative consequence of gas exploration and extraction that Wise County residents face.

Concerns regarding *community identity and character* were evident among Johnson County respondents. One respondent, for example, longed for that "small town" feel again. Others noted either perceived or anticipated increases in crime. One respondent attributed this increase to the city's efforts to increase population for tax purposes without a concomitant increase in the police force, whereas another quoted local law enforcement officials as saying that "it is due to the new crop of employees to the area from the gas development." Despite actual changes in crime rates, even such perceived or anticipated impacts can result in social disruption within a community (Brown, Geertsen, and Krannich 1989). One comment also attributed an increase in "lower income families moving in" to gas industry operations. These comments are reminiscent of preliminary key informant interviews conducted in Wise and Johnson Counties, wherein this new crop of employees and their families were called "the gas trash."

Whereas the above comments address the macro-level changes in community composition, one survey respondent observed changes in personality even among previous residents:

The new financial wealth of some (not all), from the gas checks that they are receiving has overwhelmingly changed their personalities for the worse. They went from being good country people to greedy, arrogant, selfish people who only care about themselves.

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

19

That these concerns were noted in Johnson County, but not in Wise County, may be attributable to the counties' stages of development. That is, when these data were collected, unconventional gas development was just beginning to take off in Johnson County, potentially leaving community residents with a sense of uncertainty about what to expect in the long term. Changes in community identity and character would have been fresh in the minds of respondents. In contrast, gas development operations in Wise County had been occurring for the better part of a decade, and had reached a state of maturity not yet witnessed in Johnson County. Thus, Wise County respondents may have seen their communities reach a new equilibrium, to which they had grown accustomed. Alternatively, it is possible that any changes they observed early in the development were short lived, having little or no long-term impact on community identity and character.

Traffic and road conditions. Respondents from both Wise and Johnson Counties commented on deteriorating road conditions resulting from industry operations, particularly the increased presence of overweight trucks on local roads, as indicated by one respondent stating that "gas well producers' trucks [are] tearing up the roads. Most of the roads are not made for this type of weight." In fact, energy corporations may obtain overweight permits from the Texas Department of Transportation (TX DOT), but revenue from those permits is not necessarily routed back to the Barnett Shale counties in which road repairs are needed. The wording of the permit itself reads "[i]t is expressly understood that the Texas Department of Transportation shall not be responsible in any way for any damage of whatever nature that may result from the movement of the described vehicle and load over state highways" (TX DOT 2008:1). Hence, one respondent commented that "the big semis have destroyed the roads and nothing is being done." Even where repairs are undertaken, they do not seem to last. "Roads are torn up and patched. One year later there are potholes." Beyond road conditions, traffic and congestion were cited as major problems by numerous respondents, also in both Wise and Johnson Counties. Comments dealing with the safety impacts of traffic conditions are included in the *health and safety* theme below.

Health and safety concerns. Respondents in both Wise and Johnson Counties exhibited concern over actual and anticipated health and safety impacts of increased local energy development. Three subthemes emerged within this theme, namely, *traffic accidents and fatalities*, *gas well explosions*, and *health impacts*. The increased traffic from gas industry operations is seen by respondents as dangerous, resulting in increased *traffic accidents and fatalities*. Truck drivers were called "rude," with one respondent stating that "my wife and I have both been run off the road by these

drivers. Many of my friends and family members have also had close calls with these trucks." Another respondent also indicated that "you have to drive off the road to let oil field trucks go by!!!"

Respondents also shared concerns, and even fears, about anticipated *gas well explosions*. One respondent noted that "it is scary to live so close to wells." Some responses were more tempered, citing a sense of worry, as opposed to outright fear. For example, one respondent expressed a belief that "gas explosions will become more and more frequent... I constantly worry about an explosion," whereas another added that "you never know when one might explode." One Wise County respondent went as far as to say that "it won't surprise me if Wise County is blown off the map someday." While gas well explosions are actually quite rare, previous research has shown that what is perceived as real is real in its consequences (Freudenburg and Gramling 1992; Thomas and Thomas 1928). Thus, while the impacts of anticipated explosions would not be *equivalent* to the impacts of an actual explosion (in terms of financial or health implications, for example), it is nonetheless important to understand and address the worries and fears of residents living near gas development sites.

Respondents in both study counties also commented on the perceived *health impacts* associated with various aspects of the gas industry. One respondent said that "we are grateful for the money and tax help the large oil companies provide, but not at the expense of our family's health." Another admitted that "we really don't know much about health hazards and that in itself is scary... most of us worry about whether drilling could be causing serious health implications, but we have no proof." One respondent said that the idea of having more and/or new wastewater disposal wells in the area "makes me afraid," presumably also because of health implications (i.e., potential contamination of drinking water sources). One Johnson County respondent commented more specifically that gas industry operations are "unhealthy and in my opinion a major contributor to higher cancer rates." This comment echoed concerns brought up in preliminary key informant data wherein it was alleged that experts and authorities were intentionally neglecting to conduct studies that might indicate an association between industry operations and cancer rates, lest industry revenue be lost as a result. Thus, health concerns are an important aspect of unconventional energy development, at least within the Barnett Shale.

Justice and equity. Among Wise County respondents, three subthemes comprised the *justice and equity* theme, namely, *corporate responsibility*, *trust/lies*, and a *need for*

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

21

regulation and legislation. With 16 comments in total, this was the most prevalent theme among Wise County respondents.

Corporation managers often seek a status of social license in the communities within which they operate (Gunningham, Kagan, and Thornton 2004). That is, they desire a positive image among community members, that of a good corporate neighbor. Yet, in spite of any such efforts in Wise County, the sentiment remains among at least some residents that energy companies have failed to demonstrate *corporate responsibility*. This is evidenced by claims among respondents that: “these companies do not pay to repair these roads,” that they are “greedy” and only “concerned about the bottom line,” that they are guilty of “abusing landowners,” and that they have demonstrated a “lack of interest” in the concerns of disappointed landowners. One respondent went into great detail about a specific instance where an energy company demonstrated corporate irresponsibility:

One energy company drilled a gas well 250 feet from two water wells. We tried to get them to move further again. No luck. Now we are having trouble with both water wells. Both are pumping sand. We had to replace the pump motor in one. The energy company would not accept responsibility.

Wise County respondents also commented on *trust/lies* in relation to energy development. One respondent indicated that promises made by a particular energy company “are never kept.” One such promise was that “the land would be put back to the original condition as close as possible.” Another respondent stated that “it would be good to receive revenue from the wells, instead of lies.” Finally, yet another respondent asserted that:

For decades the oil and gas industry... has lied to, and mislead, the citizens regarding the tremendous amount of damage and pollution to our water and air that they have been, and [are] presently causing. If it is not stopped and stopped soon it will be irreversible. It's already so bad that future generations will be paying a severe price for all this deception.

Respondents in Wise County also pointed to a *need for regulation/legislation*, “to protect Wise County and its citizens.” One respondent stated that for technological advancements such as desalination of wastewater to work, it would be necessary to test industry operators to “make sure they don’t cheat and take...short cuts.” In the

words of another respondent, “if the industry won’t play nice, then we need legislation. HELP!” (emphasis in original).

Power and politics. Another theme that emerged in Wise County was that of *power and politics*. Several comments referred to respondents’ varying perceptions of the roles of local government, with one respondent claiming that “county/civic leaders and gas/oil operators need to do more to show the public the benefits of existing or expanded gas operations,” and another claiming that “county government has no say in gas issues.” Respondents’ comments also showed a perceived correlation between money and power, or control. For example, one respondent stated that “old time landowners have gotten rich off of the Barnett Shale, and control a lot of...politics for their own interests.” Another asserted that:

It is very strong opinion that the oil and gas industry...have the money and the clout to influence any agency within the state in regards to how they are to protect the environment and the water tables. The Railroad Commission [which governs the oil and gas industry] from my experience is controlled by the oil and gas industry.

This comment was echoed by the respondent who stated that “the oil/gas companies are out of control. The agency overseeing them is the equivalent of the ‘fox guarding the hen house.’”

Citizen/stakeholder involvement. Some concerns regarding *corporate responsibility*, *trust/lies*, and *power and politics* identified by Wise County respondents also resonated with Johnson County respondents. However, those comments comprised just one theme in Johnson County, encompassing all issues related to citizen/stakeholder involvement. In line with the *corporate responsibility* subtheme in Wise County, one Johnson County respondent expressed that “I don’t feel like anyone is concerned about me or my property,” and another related a story about some friends who “have signed agreements for drilling...however they cannot get answers as to when drilling will start on their property.” Similarly, one respondent noted that “I would like to be informed by the gas company of what’s going on, time span and drilling, money, etc. Show me the money.” Elsewhere in the survey, in response to a question asking whether respondents had attended, or planned to attend, any industry-sponsored meetings regarding oil and gas development, another respondent wrote the following in the margin: “if they would have any.” Thus, there may be a lack of adequate communication between industry operators and local residents. Related to *trust*, one respondent expressed worry over the

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

23

possibility of “getting cheated on mineral right leases.” Finally, regarding *power and politics*, respondents exhibited feelings of defeat, saying that their concerns and complaints do not “make a difference” or “matter to anybody.” Instead, they seem to “get kicked down by richer people.” One respondent lamented that “we the people are not in control.”

Environmental Themes

Environmental themes were evident only in the Wise County data, although one Johnson County comment referenced environmental impacts as well. Environmental impacts noted by Wise County respondents fell into the themes of general *environmental concerns* and *water issues*.

General environmental concerns. Wise County respondents enumerated several environmental concerns that they perceived to be associated with local gas development. One respondent accused gas companies of “ravaging” the land, and cited “illegal dumping of waste products...out of tanks” as “a severe problem to...land and wildlife.” Others mentioned adverse environmental impacts of drilling processes on not only wildlife, but land and livestock as well. Finally, one respondent noted “very bad” pollution from diesel fumes and road dust.

Water-related issues. Wise County respondents shared 13 comments regarding the energy industry’s impact on either *water quality* or *water quantity*. *Water quality* concerns were more prevalent than *quantity* concerns, with several respondents citing past, present, or anticipated contamination of water wells. Again, “illegal dumping of waste products” was mentioned, this time as posing a “severe problem to groundwater,” and water pollution was seen as “getting worse.” One respondent lamented that “I think that in time our aquifers will be permanently damaged by all the drilling.” In terms of *water quantity*, one respondent expressed a concern over the potential of “having no water someday.” The following quotation, written by a respondent expressing a concern over “what drilling and other activities will do to our water,” summarizes both quality and quantity concerns:

Oil and big projects are not the most important issue here in Wise County—It’s the land, the people, the wildlife and our livestock, but most of all the water. Without good, quality and quantity—safe water—there is no life for anyone or anything....I believe the wells have a negative effect on the water and the land.

This perceived association between water and energy is understandable. Substantial quantities of freshwater are required for oil and gas production. Thousands of wells are fractured *at least* once (but often multiple times), and as noted earlier, each fracturing procedure requires the use of approximately five to eight million gallons of freshwater.² Thus, freshwater supplies could be greatly diminished over time. Furthermore, once the water is used to fracture a well, it is no longer fresh. Rather, it becomes highly saline and contains significant levels of total dissolved solids (TDS). That is an important concern because water resource issues are of great concern in Texas as a whole. In fact, the Texas Water Development Board (TWDB) predicts that by the year 2050, the state will fall short of its freshwater needs by as many as 2.4 trillion gallons annually if drought conditions persist (TWDB 2004). Gas industry water use, then, could compound existing water supply challenges.

CONCLUSIONS AND IMPLICATIONS

The themes identified in the comments shared by Wise and Johnson County survey respondents offer added insight that could not be obtained from quantitative responses alone. In this section, I discuss the similarities, or common themes, between the two counties. I also highlight the differences between the two counties in terms of both content and prevalence of the themes that emerged. In addition, I point out some differences and similarities that unconventional natural gas development shares with conventional energy development. Finally, I enumerate some implications of this research for various stakeholder groups within the energy development landscape, as well as for future research endeavors.

Common Themes

Common themes across the two study counties were economic and social in nature. Respondents generally agreed that local natural gas development offered *economic benefits* at both the community and the individual level, although Wise County respondents added the caveat that these benefits were not uniformly experienced by the entire local population. It should also be noted that neither of these counties has experienced the proverbial “bust” stage of development that has typically followed energy booms. Thus, the long-term economic impacts remain to be seen in both Wise and Johnson Counties.

²Personal communication with David Burnett, March 2006.

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

25

In terms of social consequences, respondents perceived threats regarding *health and safety*, as increased *traffic accidents and fatalities*, *gas well explosions*, and general *health implications*. Further, they saw *quality of life and community identity* as threatened by the activities undertaken by gas industry operators, whether defined as *aesthetic degradation*, personal *inconvenience*, or loss of *community identity and character*. Finally, *traffic and road conditions* constituted a major theme in both counties.

Differences between Counties

Several important differences also emerged from the analysis. Most notably, both environmental themes, general *environmental concerns* and *water issues*, surfaced only in Wise County. One likely explanation for this fact is that Wise County has reached a more mature production phase, which intensifies the need to dispose of wastewater and other byproducts of the hydraulic fracturing process. Concern over the placement of injection wells for waste disposal may thus be more visible and imminent than in Johnson County. Regarding water quantity issues, our preliminary key informant research suggested that there may be a greater level of perceived security in the sufficiency of surface water resources in Johnson County than in Wise County. Aside from these potential explanations, future research should examine more thoroughly the reasons for this disparity between the two study counties.

Another difference between the two study counties was that of the subthemes within the *quality of life and community identity* theme. Whereas Wise County respondents expressed concern over factors labeled *inconvenience*, Johnson County respondents focused more on the changes they had witnessed regarding *community identity and character*. Concerns regarding inconvenience may be greater in Wise County because of the *amount* of industry activity (i.e., a greater number of drilling rigs, gas wells, and trucks). Johnson County concerns regarding community identity and character, on the other hand, more likely reflect the differences in *stage* of industry development between the two counties.

Although not identically titled, the themes of *justice and equity* and *power and politics* that emerged in Wise County contained comments similar to those comprising the *citizen and stakeholder involvement* theme identified in Johnson County. Nuanced differences resulted in the differing theme titles. The Wise County comments within the *justice and equity* and *power and politics* themes were also more numerous than the Johnson County comments, allowing for further division into themes and subthemes. Namely, whereas Johnson County respondents

made only eight comments reflecting the *citizen and stakeholder involvement* theme, Wise County respondents made twenty-four comments along similar lines, which were divided into two separate themes, one of which (*justice and equity*) was further divided into three subthemes. Thus, the concerns expressed therein were seen as more prevalent in Wise County than in Johnson County. This difference in prevalence may be due, in part, to the differences between the counties regarding both the intensity and duration of industry activity experienced.

Other differences in theme prevalence also emerged between the two counties. For instance, *health and safety* concerns were cited more frequently in Wise County than were *traffic and road conditions*—the reverse was true in Johnson County. As with the environmental themes, the more mature stage of development, as well as the consequently higher concentration of drilling rigs, gas production wells, and injection wells, may explain this difference.

Unconventional Versus Conventional Energy Development

The results featured here show some similarities between the unconventional energy development occurring in the Barnett Shale and the conventional energy development that prompted the boomtown research of the past. For instance, many positive comments revolved around the *economic* benefits to be obtained from development. Likewise, economic concerns over the distribution of those benefits were common across these two types of development. As for social impacts, residents in both types of energy development community reported crime increases as an energy-related impact. Environmentally, many similar concerns surfaced, particularly in Wise County, where air quality and wildlife were noted as suffering from industry development. Of course, in unconventional development, respondents also noted impacts on water quality and quantity—an environmental impact unique to this type of development.

Other differences between conventional and unconventional energy development contexts included an absence of several common boomtown impacts within the themes. For instance, comment providers in this study did not allude to increased costs of living or housing shortages. Also, rather than citing infrastructural shortages, they were more concerned with the conditions of the existing infrastructure, namely the roads and streets. These differences are likely the result of the metropolitan context of Barnett Shale development combined with the technological nature of the development, as highlighted above. The similarities and differences shown here exemplify the need for research on the impacts associated with each new type and context of energy development. That is, the

impacts cannot be assumed to either directly mirror those of previous forms of extraction, or disappear with the onset of modern technological advancements. Rather, addressing and minimizing impacts requires that they first be uncovered.

Implications

The present study highlights economic, social, and environmental impacts of the unconventional natural gas industry operating within the Barnett Shale region of Texas. As such, the results of this analysis have implications for various stakeholders within the landscape of unconventional natural gas development, including community leaders, industry operators, and local residents. In addition, they have the potential to advise future research on unconventional energy development.

Community leaders, such as local elected officials, are charged with acting for all of their constituents. Therefore, it is important for them to recognize the potentially disparate impacts of energy development activities on various population groups within their jurisdictions, and to consider those disparities in their policymaking decisions. Furthermore, particularly at a macro level, they should work to ensure appropriate distribution of revenue from industry operations. For instance, funding for road repairs should be equitably allocated to all areas of the community that experience industry-related road damage. Finally, community leaders should serve as liaisons between industry operators and citizens, using their authority to hold developers accountable for the consequences of their actions.

Energy industry operators should also play a role in reducing the adverse impacts of natural gas development. The narratives expressed in the comments presented here make it clear that energy companies are not uniformly viewed in a positive light. Although the extent to which these comments represent the views of the broader population cannot be stated with certainty, the views are clearly present among at least some residents within Wise and Johnson Counties (see also, Theodori 2008). Throgmorton (1996) has suggested that such narratives can powerfully influence political and planning decisions, and thus should be taken seriously by industry operators.

In response, then, to the importance of public opinion and support, industry managers should work to improve communication with, and information provided to, the public. They should engage concerned citizens in an ongoing dialogue about their experiences, worries, and fears. Additionally, they should be proactive in preventing adverse impacts of development upon local residents. Likewise, when unavoidable or unforeseen impacts do occur, they should respond swiftly to rectify

those impacts, including appropriate compensation when necessary. Finally, they should consider the potential economic, social, and environmental impacts of their processes, and work diligently toward improving those processes to minimize negative impacts.

Local residents also have responsibilities in the arena of local natural gas development. First, they should actively seek out information regarding energy development as well as their options and rights as citizens and/or landowners. One respondent lamented, "I am not sure if we had it to do over again we would lease our mineral rights." By seeking more thorough information, such regrets might be avoided. Several respondents within both study counties evidenced a lack of awareness or understanding of local energy development. One Johnson County respondent stated simply that "I am not aware of any exploration or production," whereas another incorrectly asserted that "there is no oil or gas in Johnson County." Other Johnson County comments echoed these sentiments. A similar lack of awareness was evident in Wise County, although respondents there typically offered some excuse or explanation for this, such as being elderly, or new to the area, as though they believed that they should be more knowledgeable about the subject of energy development. Secondly, residents must communicate their concerns to both local leadership and industry professionals, in a timely fashion, so that both groups have an opportunity to respond to and rectify any adverse impacts suffered because of industry operations.

Although the present study cannot be generalized to a broader population or to other contexts, its findings may be of value in other areas where unconventional natural gas development is being instituted or considered. Various stakeholder groups can probably learn from the experiences of communities where existing development is occurring. For example, community leaders can be proactive in negotiations with developers. Both community leaders and industry operators can work to actively engage the public at the outset of development projects and at various stages of development. Residents, in turn, can play an active role in the shape that local gas development takes, by actively seeking out information and providing feedback to both community leaders and industry operators.

This study also suggests directions for future research. As unconventional natural gas development expands to other regions around the nation, researchers may explore the extent to which those new locations resemble and/or differ from the Barnett Shale. For instance, they should determine whether the same types of themes emerge in other contexts. If not, their findings might suggest local conditions contributing to observed differences. For instance, the impacts of

LOCAL PERCEPTIONS OF ENERGY DEVELOPMENT

29

unconventional natural gas development may differ within more rural, less metropolitan contexts.

Results from qualitative thematic analysis should also be compared with findings from larger-scale quantitative studies to determine the prevalence of identified themes at the population level. These future research directions will further expand our understanding of the economic, social, and environmental impacts of unconventional natural gas development, to inform and advise stakeholders at all levels within the energy development landscape.

AUTHOR BIOGRAPHY

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31

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