Constrained Choice and Climate Change Mitigation in US Agriculture: Structural Barriers to a Climate Change Ethic

Introduction

Agricultural uses account for over 50% of the land base in the continental United States (US) with over 99% of cropland privately owed and operated (Lubowski et al. 2006). How this land is managed can result in environmental degradation including water pollution (Ribaudo and Johansson 2007), habitat loss (Kerr and Deguise 2004), and the emission of greenhouse gases (US EPA 2013). A growing body of research has focused on how the decisions of individual farmers determine environmental outcomes. This work has examined the role of demographic and socio-economic variables (e.g., Buttel and Newby 1980; Napier et al. 1988); personal beliefs, values, and ethics (e.g., Napier et al. 1986; Napier & Camboni 1988; Napier et al. 1988; Morris et al.; 2000); and social networks and social capital (e.g., Rogers 2003; Lubbell and Fullton 2007 and 2008). However, it is now recognized that in addition to these individual and community scale factors, political and economic drivers – located off the farm and outside the community - are increasingly important drivers of land management and environmental outcomes (Atwell at al, 2009; Atwell et al. 2010; Stuart and Gillon 2013). In this case study we examine how seed corn contracts create structural barriers that constrain management decisions and inhibit the development of a climate change ethic among farmers.

Both downstream buyers of agricultural products and upstream suppliers of agricultural inputs influence farm management practices and shape environmental impacts. This influence can occur through the use of production contracts (Hinrichs and Welsh 2003; Hendrickson and James 2005). Production contracts can dictate farming practices, constrain choices, and result in

situations where farmers feel they have to contribute to environmental degradation and that they cannot participate in environmental practices and programs that would reduce degradation. This has been found to be especially true in cases where a few companies control access to a commodity market (Hendrickson and James 2005). In addition, constrained choices imposed through production contracts may result in the rationalization of unethical environmental behavior and the overall erosion of farm ethics (Hendrickson and James 2005; Stuart 2009). Taking this notion further, we contend that constrained choices imposed through contracts can also inhibit the development of new farmer ethics, in this case a climate change ethic.

This paper focuses on seed corn farmers in Michigan and explores how contracts with seed companies hinder the development of a climate change ethic in which responsibilities as a global citizen are prioritized over individual identity and goals. Agriculture is increasingly both impacted by and implicated in greenhouse gas emissions (IPCC 2007; Weiss 2010; CAST 2011). More resources are therefore being devoted to climate change adaptation as well as to reducing greenhouse gas emissions through the adoption of mitigation practices. One way corn farmers can cut greenhouse gas emissions is through reducing the application of nitrogen fertilizer. This paper explores the possible effectiveness of a climate change mitigation program focused on incentives for reducing nitrogen fertilizer in corn production. We find that contracts with seed corn companies constrain farmers from considering such a program and continue to create incentives for over-applying nitrogen fertilizer. This causes farmers to dismiss environmental issues as being out of their control and may result in the erosion of environmental ethics among seed corn farmers and inhibit the evolution of a climate change ethic. Programs aiming to enroll

seed corn farmers in mitigation efforts will need to directly address the seed corn companies whose competitive "tournament" contracts continue to drive the over-application of fertilizer.

Climate Change and Agriculture

While agriculture results in the emission of several greenhouse gases, this study focuses on nitrous oxide. Agricultural soil management practices are responsible for 68% of US nitrous oxide emissions, primarily from nitrogen fertilizer application (US EPA 2009). This is significant given that nitrous oxide's warming potential is approximately 300 times that of carbon dioxide (IPCC 2007). Scientists have successfully linked nitrous oxide emission levels to the amount of nitrogen fertilizer applied in cropping systems (Millar et al. 2010). The use of nitrogen fertilizer has increased 16% between 1990 and 2007 in the US (USDA Economic Research Service 2012) and farmers in the US apply approximately 13.5 million tons of nitrogen fertilizer each year (Association of American Plant Food Control Officials and The Fertilizer Institute 2013). Agronomists estimate that at least 50% of US farms still apply more fertilizer than recommended (Millar et al. 2010).

A reduction in nitrogen fertilizer application rates represents one of the most effective climate change mitigation strategies farmers can adopt (Snyder 2009). Basing application rates on detailed estimates of plant nutrient use, using the appropriate depth for below ground delivery, careful timing of application to reduce loss, accurate delivery using soil testing, and using slow or controlled release products can all increase the efficiency of nitrogen use and therefore decrease the overall rates of fertilizer applied (Council for Agricultural Science and Technology 2011; IPCC 2007; Robertson 2004; Snyder et al. 2009). Adopting these measures

could reduce nitrous oxide emissions from 9-26% below current emission levels (Cole et al. 1997).

Given that nitrous oxide is a primary concern regarding greenhouse gases from field crop agriculture, agricultural scientists have developed a protocol for supporting offsets payments based on reductions in nitrous oxide emissions (Millar et al. 2010). The program is intended to increase nitrogen use efficiency without reducing yields. In such a program, farmers could be paid for reduced nitrous oxide emissions based on the carbon equivalence. Regarding the incorporation of farmers into a carbon market, Suddick et al. (2010) state that there are many challenges ahead and call specifically for more social science research on priority awareness, social barriers, and policies to increase the adoption of mitigation practices. Responding to this call, we examined barriers that corn farmers face when considering participation in a potential climate change mitigation program and how these barriers can hinder the development of a climate change ethic. Going beyond the typical studies on farmer beliefs and attitudes about climate change, we focus on structural constraints imposed on farmers that can limit the success of mitigation programs and their implications for developing a broad climate change ethic in which responsibilities as a global citizen are prioritized over individual desires and local benefits.

A growing number of social scientists have explored farmers' beliefs about climate change, and how their beliefs and attitudes about climate change impact their willingness to participate in adaptation and mitigation efforts. Results from US studies reveal that while a small majority of farmers may believe that climate change is occurring, fewer farmers believe that human activities represent a primary driver (Haden et al. 2012; Arbuckle et al. 2013; Gramig et

al. 2013; Rejesus 2012). While many argue that proactive climate change actions require farmers to first perceive climate change as a risk to agriculture (Howden et al. 2007; Gramig et al. 2013), studies reveal that many farmers do not perceive climate change as a threat (Rejesus 2012; Haden et al. 2012; Gramig et al. 2013; White and Selfa 2013; Arbuckle et al. 2013). In general, studies indicate that most American farmers do not believe that climate change is a serious threat: it is viewed as something that may or may not occur and if it does occur it would be in the distant future (Haden et al. 2012; Holloway and Ibery 1996).

There are many barriers to increasing farmer participation in climate change mitigation efforts. As described above, one challenge remains that most American farmers do not view climate change as a real concern. Mitigation is also dependent on the rationale that human emissions of greenhouse gases are the major driver of climate change. Adaptation to climate variability is something farmers have always done whether or not they believe in human-induced climate change, whereas mitigation actions are unlikely to be adopted unless a farmer believes that climate change is a human driven phenomenon (Arbuckle et al. 2015). In addition, participating in mitigation efforts largely depends on the development of a new globally oriented climate change ethic. More farmers are interested in climate change adaptation compared to mitigation because they result in local benefits compared to mitigation actions that focus on reducing greenhouse gas emissions for global benefits. Benefits may not be directly noticed or realized by the farmer who is adopting the mitigation practice (Arbuckle et al. 2015). Therefore we contend that the adoption of mitigation practices demands a new farmer ethic beyond regionally focused environmental stewardship. It requires a globally oriented climate change ethic. Much like Aldo Leopold's Land Ethic, a climate change ethic would transform the farmer

into a global climate citizen. Non-governmental organizations, university extension, and environmental groups are already attempting to instill such an ethic through farmer education programs.

While education programs about climate change may play a role in convincing farmers that climate change is real and instilling a climate change ethic, we contend that structural constraints will limit the development of such an ethic and participation in climate change mitigation efforts. The current political economy of the industrialized agri-food system will continue to impede the success of climate change mitigation efforts by limiting the development of a climate change ethic. If farmers feel they cannot act to mitigate climate change they will continue to rationalize unethical climate behaviors, denying climate change and their role as contributors. We contend that despite educational efforts or incentives, the adoption of mitigation practices will remain limited without significant structural changes including reform of production contracts. To illustrate this, we examine how seed corn contracts in southwest Michigan constrain farmer participation in mitigation efforts and inhibit the development of a climate change ethic.

Seed Corn Production

Corn production is one of the most significant sources of nitrogen pollution in US waterways as well as in the air as nitrous oxide. In the US, approximately 50% of all nitrogen fertilizer is applied to corn (USDA Economic Research Service 2012) and corn has an especially low nitrogen use efficiency – approximately half of the fertilizer applied is lost to the

environment. Focusing mitigation efforts on corn production therefore makes strategic sense. As stated above, scientists contend that one of the most effective climate change mitigation strategies in agriculture would be reducing the application of nitrogen fertilizer (Snyder et al. 2009). In this study, we focus on a possible market-based offsets program that would pay farmers to reduce nitrogen fertilizer application, as described by Millar et al. (2010). We examine possible participation in this program among seed corn farmers in southwest Michigan and identify barriers to participation and the evolution of a climate change ethic.

While commercial corn farmers grow corn primarily for corn syrup, ethanol, and animal feed; seed corn farmers grow corn that will later be sold as seed to commercial corn farmers. Seed corn farmers enter into contracts with seed companies that assign them specific varieties of corn to grow based on projected demand for seed. Studies have found that contracts are associated with higher levels of chemical inputs (Winters, Simmons, and Patrick 2005) including nitrogen fertilizer (Jolejole 2009; Preckel et al. 2000). Due to higher levels of fertilizer application, seed corn production is associated with the degradation of ground and surface water. Many regions that specialize in seed corn production are well known for water polluted with unsafe levels of nitrates. Although there is significantly less land used for seed corn production compared to commercial corn, because seed corn farmers apply more fertilizer, reducing the application of nitrogen in seed corn production would help reduce greenhouse gas emissions.

Most seed companies contract with corn farmers for hybrid seed production for later years of commercial corn planting. Seed corn companies are constantly coming out with new varieties of corn that are high producing, hardy, and have modifications such as herbicide

resistance (Darrah, McMullen, and Zuber 2003). Due to lower inbred vigor and the need for genetic integrity, growing seed corn demands very specific conditions compared with commercial corn. When growing seed corn irrigation, field location, and soil characteristics take on a greater importance. Seed corn farmers are under contract to grow new and experimental varieties of corn for seed and the companies use contracts to mitigate risks and reduce costs associated with production (Jones et al. 2003).

Seed corn contracts offer farmers the potential for higher profits compared to growing commercial corn (Preckel et al. 2000). However it is highly competitive and risky, and can result in significant losses if a contract is not renewed. Most seed corn contracts are "tournament" contracts in which individual growers are ranked against others growing the same or similar varieties. These competitive "tournament" contracts are organized as principal-agent agreements between the seed company (principal) and contracted farmer (agent) (Preckel et al. 2000). In particular, the seed company benefits from this arrangement because optimum yields are provided without the company needing to acquire land or machinery (Hamilton 1994). The primary goal of a tournament contract is to encourage competition between agents, therefore, they offer highly lucrative incentives for above average yield performance (Nalebuff and Stiglitz 1983) and performance is linked to contract renewal.

Southwest Michigan is home to a large number of seed corn growers. Both Pioneer and Monsanto have regional seed corn production headquarters in St. Joseph County and contract with farmers in the surrounding area. Agricultural census data does not distinguish between commercial and seed corn acres, however, industry representatives estimated that southwest

Michigan has over 100,000 acres in seed corn production. Due to high rates of nitrogen fertilizer application, this region has a history of nitrate pollution in ground and surface waters (Michigan Department of Environmental Quality 2015). We contend that the region is therefore also a key area to explore participation in a climate change mitigation program as it is also responsible for nitrous oxide emissions. In this paper we examine barriers to participation in mitigation efforts linked to concentrated power in the seed corn market and how this can constrain the choices of farmers and hinder the evolution of a climate change ethic.

Concentrated Markets, Constrained Choice, and Ethical Implications

In general, the industrialization of agriculture has resulted in industry consolidation with fewer firms shaping production standards and therefore land management (Bonnano et al. 1994, Morgan et al. 2006). This has resulted in concentrated markets for many agricultural commodities (Hauter 2012). When four or fewer farms control over 40% of a market, the industry loses competitiveness (Hendrickson and Heffernan 1999) and in many agricultural sectors (including dairy, poultry, and seed) oligopolies reap huge profits (Hauter 2012).

The seed industry was one of the first agricultural industries to consolidate, mostly during the 1970s due to patent protections that attracted chemical and oil companies to add seed to their portfolios (Howard 2009). Monsanto and Pioneer control the majority of the seed corn market. Monsanto is the world's largest producer of genetically modified seed, owning over 650 agricultural patents, and is the dominant player in the seed industry (Hauter 2012). It was the first company to introduce stacked traits in corn – seeds with multiple traits such as Round-up ready and corn borer resistance. In 1998 Monsanto acquired DeKalb, Holden, and Cargill's

international seed business. In the same year Dupont purchased Pioneer seed company (Hauter 2012). Together Monsanto and Pioneer control 65% of the US seed corn market (Howard 2009). According to industry representatives, in southwest Michigan these two companies control about 75% of the seed corn market and have a major influence over regional production practices.

In cases where a few companies control access to markets, farmers can experience constrained choices, especially farmers who work under production contracts (Hendrickson and James 2005; Stuart 2009). Contract farming allows companies to limit their liability and to externalize risks (Ashwood, Diamond, and Thu 2014). Contract farming has emerged in an array of agricultural sectors and regions with negative consequences regarding labor and environmental outcomes (Ashwood et al. 2014; Borlu 2015; Burch 1994; Dixon 1999; Goss, Skladany, and Middendorf 2001; Mabbett and Carter 1999; Vandergeest, Flaherty, and Miller 1999; Vandergeest et al. 1999; Welsh 1997). As seen in in the poultry and leafy green sectors, contracts constrain production choices because companies can stop contracting with farmers who do not comply with the terms of their contracts (Constance and Heffernan 1991; Heffernan and Lind 2000; Stuart 2009). When only a few companies control access to a market, farmers have little choice but to comply with the terms dictated by the companies. These constraints are amplified by the increasing economic pressures farmers face (Hendrickson and James 2005).

As described by Hendrickson and James (2005), constrained choice may have serious ethical implications. Constrained choice can alter a farmer's self-identity and result in a reduction in personal ethical standards. Constrained choice can also result in ethical dilemmas for farmers. James (2003) explores the application of a typology of ethical dilemmas. These

include “right vs. right” dilemmas and “right vs. wrong” dilemmas. Here we focus on “right vs. wrong” dilemmas where farmers have incentives to adopt unethical behaviors. As described by James (2003), institutional factors such as policies to comply with production contracts can create ethical dilemmas. When institutional incentives encourage unethical behavior farmers may feel they have no choice and must adopt the unethical behavior. This is seen as the rational response and the long-term rationalization of unethical behavior can result in the overall erosion of farmer ethics: behaviors that once seemed unethical become the new norm. In this case, the ethic in question is a climate change ethic in which global climate responsibility subjugates individual gain. We contend that constrained choice also hinders the development of new farmer ethics, in this case a climate change ethic. This paper focuses on how seed corn contracts in southwest Michigan shape environmental behavior, constrain farmer participation in a climate change mitigation program, and hinder the development of a climate change ethic. This work is critical to inform climate change mitigation efforts that focus on farmer education and incentives while overlooking structural barriers.

Methods

This paper draws from a larger study where the authors used mixed methods including a mail survey, personal interviews, and focus groups to examine nitrogen fertilizer use in both commercial and seed corn production ins southwest Michigan (XXX 2014). Here we focus solely on seed corn and draw from personal interviews and a focus group with seed corn farmers.

In-depth interviews were conducted with key informants and seed corn farmers in southwest Michigan within St. Joseph, Branch, Calhoun, and Kalamazoo Counties. In the winter

and spring of 2011 we conducted 24 personal interviews with seed corn farmers in the region. Interview questions focused on factors influencing nitrogen fertilizer application, willingness to reduce application, interest in participating in a nitrogen offsets program, and general questions about global climate change. Six key informant interviews were also conducted with representatives from companies that produce parent seed stock, independent wholesale companies who grow out seed stock from other manufacturers, and crop consultants who provide services for both commercial and seed corn farmers. Recordings and notes were transcribed and analyzed using NVivo software (QSR International 2010), and coded for major themes using a grounded theory approach (Charmaz 2006).

In March of 2011 we conducted a focus group with six seed corn farmers in St. Joseph County. The first questions focused on what factors influence nitrogen fertilizer use and tools and challenges to increasing nitrogen use efficiency. Then, a possible climate change mitigation program focused on reducing nitrogen fertilizer use was presented. The second set of questions focused on participation in such a program, barriers to participation, and opinions about climate change in general. The focus group was recorded, transcribed, and analyzed using NVivo software (QSR International 2010) and grounded theory coding (Charmaz 2006).

Results

Of the 24 seed corn farmers interviewed, 10 participants also produced commercial corn. Total acreage represented by this sample was 26,430 seed corn acres with an average farm size of 1,149 acres. Key informants indicated that close to 100,000 acres are in seed corn production within the southwest Michigan region. This sample then represents approximately 25% of the

contracted acreage. Of the seed corn farmers participating in this study 15 participants contracted with Pioneer, 5 contracted with Monsanto, 3 with Remington, and 1 with Mendon Seed Growers.

Interviewees heavily prioritized yield in their production, connecting this to the structure of their production contracts. Seed corn farmers interviewed indicated that high yields are very important in their operation: 63% of the interview participants noted that high yields were either most important in their business or directly tied to high economic return. "Tournament" contracts provide financial incentives for individuals whose yield is above average and penalize individuals with yields below the average for a particular hybrid. One farmer explained, "…high yields have to be where your emphasis is put as a seed grower or you will get killed." Farmers shared that if they did not prioritize yields they would lose money and risk losing their contract with the seed corn company. Interview respondents described the competitive pressures that influence their management decisions. One farmer related, "if you don't meet your goal you run the risk of losing your contract so it's very competitive … whether you are competing against yourself or everybody else." Another explained, "you wouldn't think that 2 bushel per acre would make a difference but it could because you compete with everybody that's growing that same variety and 2 bushels could make it or break it."

Although all of the interview respondents agreed that contractual language allows for alternative nitrogen management practices, the competitive process greatly constrains fertilizer choices, especially any reduction in fertilizer use. Respondents explained that the competition prevented nitrogen reductions because any yield loss would correspond with penalties. One farmer interviewed stated, "They don't expect a certain amount [of fertilizer applied] but they

expect results. If I was to cut my nitrogen and my yields go down I wouldn't have a contract." Participants agreed that it is difficult to calculate how an additional unit of fertilizer or water impacts yields, so to reduce risks they add more of both. All farmers in the focus group agreed that their contracts drive over-application of nitrogen and that most farmers are applying more than they need. As one farmer stated, "contracts drive abuse." Another admitted: "I think I do apply more than I need, you can see it from the data." In some cases companies specifically told farmers that they need to be applying more nitrogen: "They had us up our nitrogen rates in the last 2 years over what we were doing because they felt we weren't competing as favorably because we weren't putting on enough nitrogen."

Interest in participating in a possible climate change mitigation program was low among seed corn growers. Interviewees connected this to a fear of production loss and of alienating the seed corn companies. Only 25% of the seed corn growers interviewed indicated that they would consider participating in an offsets program with payments tied to nitrogen fertilizer reduction. However, these farmers agreed that any financial incentive through an offsets program would have to be more substantial than the financial rewards they received from the seed corn companies. One farmer interviewed explained that, "With a competitive contract, if you get a top yield on a field, that's a big bonus. So it [the incentive] would have to be huge. You're pretty much stepping out of that competition part of it." Most respondents said they would not participate because they did not want to jeopardize their relationship with the seed company. One farmer in the focus group stated, "we don't want to make the company mad." Most participants indicated that they would not even be comfortable talking to the seed company about such a program in case the conversation would jeopardize their contract. One farmer said: "Well, our

company here, they make it very clear. If you're unhappy with this thing or that thing, you come in and you moan and whine about this, there's a whole list of people….. Yeah, there's ten guys looking to jump in your place."

Among the seed corn farmers interviewed and in the focus group there was a general consensus that they would only participate in an offsets program if the following conditions were met: the program was supported by the seed corn company, it could be shown that it would not reduce yields, and therefore it did not jeopardize their contracts or their positions in the competition. If these conditions were met then they might participate. However, they also agreed that the seed corn companies would not support reducing nitrogen fertilizer for a climate change mitigation program. A farmer in the focus group stated "you would need real buy in from the companies" and another added, "it would be a hard sell [to the seed corn companies]." Another farmer explained that if the seed companies are not addressing any of the local water issues, it seems clear they will also be unwilling to address nitrous oxide emissions: "it would have to have company buy in, they won't even buy in on the water issue."

Farmers interviewed and in the focus group described how the competitive system changes the farming community and leads to a lack of trust and secrecy between seed corn growers. In the focus group a farmer explained how the structure of the contracts affects farmers' feelings towards one another: "One of the things that is difficult about growing seed-corn is that if the field across the road is planted the same as mine, and I'm competing against it, then it's hard for me to ever feel good about seed on my neighbor's ground." Another farmer interviewed described how secretive seed corn farmers are: "It's exceptionally competitive: a lot of people

won't even tell you who they use for book keeping…..the seed companies also highly discourage any interaction amongst growers; they do not want growers talking back and forth." A farmer in the focus group flatly stated, "I wouldn't share my [fertilizer] rates." Another said: "the company loves the idea of keeping us at each other's throats."

Seed corn farmers participating in this study identified distrust and ensuring equal participation by all farmers as a significant challenge to participation in a climate change mitigation program. Distrust amongst seed corn farmers was identified as a significant constraint to reducing nitrogen fertilizer application. One farmer stated: "There are those guys out there that would say 'yes' but if everyone would decrease nitrogen they would increase theirs just to try to take advantage of it, or at least that's the feeling that a grower has." Another interview respondent explained, "It's kind of a dynamic thing because if one grower agrees to live by this it allows another grower to opt out and use more and if he is successful at increasing his yield significantly above yours then it drives your income lower."

Seed corn farmers interviewed demonstrated a low awareness of the associations between nitrogen fertilizer, nitrous oxide, and climate change. Only one seed corn farmer acknowledged the association between nitrogen fertilizer and nitrous oxide gas and only two seed corn farmers claimed they were aware that nitrous oxide is a greenhouse gas. None of the respondents associated nitrogen fertilizer with climate change and six denied that climate change was a real phenomena. In the focus group, a lively discussion about climate change took place with a variety of opposing views. When the relationship between nitrogen fertilizer, nitrous oxide, and

climate change was presented the focus group participants agreed that they did not know anything about this relationship. One farmer stated, “I had no idea.”

Although they were not asked about water issues, the seed corn farmers participating in this study expressed greater awareness of water-related issues compared to climate change. Approximately 42% of seed corn farmers interviewed brought up water related issues. Some comments related to the pollution of groundwater with nitrates. One respondent explained, “Constantine really struggled for a while getting their public water to meet the requirements because of nitrates.” Water availability was raised as an emerging issue due to the irrigation requirements of seed corn production:

> “We have been pumping water out of the ground here for 30 years in St. Joe county and really nobody ever got a good baseline and now we have more population and people that see us turning the water on and potentially depleting the area of the ground water and that is something I think we all have to watch as farmers.”

Interview participants largely agreed that issues related to irrigation were likely to become more intense in the near future and many feared possible government involvement.

Among the farmers interviewed, many expressed that they consider themselves good environmental stewards and see this as part of their role as a farmer, however they did not identify climate change as part of their identity as an environmental steward. About half of the respondents acknowledged local water quality issues related to fertilizer use. One farmer stated,

"We really need to watch it. We don't want to ruin our water supply." Another explained, "We don't want to drink the herbicides and the nitrogen." However, when climate change was mentioned most participants did not see climate change as real, or as an issue of concern, and did not tie it to their identity as good stewards. Only a few farmers stated that they believed in climate change. One focus group participant shared that he believed Michigan had experienced more severe rain events in recent years and another felt that the temperatures seemed warmer now than 30 years ago. Only one farmer shared that he believed climate change mitigation would eventually become part of farm stewardship:

> "We talk about being good stewards of the land, but for a long time my dad never thought about cattle manure running down in the well water and getting nitrates or atrazine in the water . . . and now it is common knowledge. I think the way we look at ground water our kids will look at the atmosphere . . . I think it is just the next step of evolutionary thought about how we are contaminating things."

This respondent was the only farmer in the study to mention a possible evolution of farm ethics to include atmospheric and climate stewardship.

Rather than embrace a climate change ethic, many seed corn farmers rejected their role as a global climate citizen by emphasizing trade-offs between yield and economic gain. One farmer explained the struggle between economic gain and potential climate mitigation:

> "I think I keep coming back to that same thing, how are you going to produce a crop? You got to do it somehow, so I'm struggling with the fact that unless it's proven to me That it {reducing nitrogen fertilizer} is having an effect on {climate change}, that's going to be really hard to get me to change. It really is."

Another respondent emphasized his unwillingness to sacrifice potential economic gain when asked if he thought farmers could play a role in reducing climate change: "To a point possibly, but yet on the other side, I think that most farmers are more concerned about the bottom line." One farmer discussed directly the connection between contracts and this trade off between economics and climate change mitigation: "I don't know, I think we are doing what we can right now because it's not an economically sound practice {to reduce nitrogen}. We're not going to basically bite the hand that feeds you." Instead of a climate change ethic, study participants focused on these trade-offs related to productivity and economic gain.

Seed corn farmers also rejected a climate change ethic by shifting responsibility for climate change to other actors, primarily urban and suburban residents and industries. One farmer said: "I mean obviously from the standpoint of fertilizer application and notably nitrogen application, I think that the urban/suburban group that is applying fertilizer to their lawns at a rate that far exceeds what we apply on an area basis." Another said: "I don't think farmers will have that big of an effect {on climate change}. I think your large industries and things like that are the ones that you really have to go after." Another interviewee expressed: "You know I'm as environmentally sensitive as everybody else, but I think us as farmers try to be more environmentally sensitive than most people, you know it's how we make our living. You look at

people that live on lakes and I guarantee their water is much more polluted and they are getting much more runoff into their lake than what we are." Seed corn farmers commonly used their identity as "good stewards" to diffuse the notion of a climate change ethic and repeatedly highlighted the lack of an environmental stewardship ethic among other groups.

Overall, study participants indicated that, despite their views on climate change, the structure of seed corn contracts represented a significant barrier to reducing nitrogen fertilizer use and developing a climate change ethic. They agreed that contracts create distrust and make it economically gainful to apply excessive nitrogen. They also agreed that seed companies would not support a mitigation program aimed at reducing nitrogen application, especially when companies are actively encouraging farmers to increase nitrogen application to ensure higher yields. In summary, seed corn farmers used their production contracts, the atmosphere of distrust created by their contracts, trade-offs with maximizing economic return, and the responsibilities of other polluters to justify a rejection of a climate change ethic.

Discussion

Each year an increasing number of education programs are emerging across the US focusing on sharing information with farmers about climate change and practices for mitigation and adaptation. Efforts are primarily being led by government agencies, non-governmental organizations, and university agricultural extension services. These organizations have developed fact sheets and other literature about climate change for farmers and some have held workshops and discussion forums. These efforts aim to educate farmers about climate change, convince them that it is a real issue to be addressed in the near future, and teach them how to

adopt new practices to prevent or adapt to change. We contend that these efforts are trying to instill a climate change ethic and recruit farmers to address this critical global challenge. However, as we have explored in this study, in certain cases institutional or structural barriers exist that will constrain action, allow farmers to rationalize ignoring climate change, and hinder the development of a climate change ethic.

This case study identifies a significant barrier to the success of climate change mitigation efforts: how powerful agri-food companies constrain farmers' choices and shape land management practices through production contracts. Seed corn production exists in a concentrated market with 65% controlled by two companies, Pioneer and Monsanto (Howard 2009). In southwest Michigan this number increases to 75% of the market controlled by these two companies and seed corn farmers have few options regarding who to contract with. We have shown that, as described by Hendrickson and James (2005), this concentrated power constrains farmers' choices and in this case will hinder their participation in a climate change mitigation program. Most farmers participating in this study seemed to easily accept that while under contract with a seed company they could not participate in climate change mitigation efforts, despite any financial incentives. This allows farmers to rationalize continuing to ignore climate change and any contributions they have to greenhouse gas emissions. Further, mistrust among farmers and perceived trade-offs between personal productivity and potential global climate benefits are structurally reinforced by seed corn contracts. Institutional constraints imposed by seed company contracts will continue to reinforce current trends to ignore the threat of climate change. Mitigation programs need to be aware of such barriers for seed corn and other

concentrated production systems where a few companies drive land management decisions. If a climate change ethic is on the horizon, this trend will hinder the development of such an ethic.

As climate change educational efforts continue, a growing number of farmers might find themselves facing ethical dilemmas. As described by James (2003) institutional factors can create ethical dilemmas for farmers. These include "right vs. right" dilemmas and "right vs. wrong" dilemmas. Our study only identified a few farmers that may be facing a "right vs. wrong" dilemma. These farmers believe in climate change and believe farmers should take action. However, they feel they cannot take action due to the competitive nature of the seed corn contract system. These few farmers felt that they had no choice but to comply with company expectations, despite their personal beliefs about climate change and their contribution to greenhouse gas emissions. As climate change education programs continue and expand, we may see more "right vs. wrong" dilemmas where farmers know they should do something to reduce emissions but structural factors continue to encourage greenhouse gas emissions. As shown in this case study, when faced with this dilemma farmers will likely remain constrained by institutional factors and rationalize their unethical behavior (e.g., "I have no choice"). We found that the majority of seed corn farmers failed to acknowledge climate change as a legitimate risk or expressed it as a "right vs. right" dilemma in which productivity and climate change are in conflict. These institutional factors in the seed corn sector may lead to the erosion of environmental ethics among farmers (Hendrickson and James 2005) and prevent the development of a new globally oriented climate change ethic.

We have identified barriers to climate change mitigation specific to contract farming in a concentrated market; however, education and incentive programs should also be aware of other structural barriers to mitigation. Efforts blindly focused on education and incentives overlook how the political economy of industrialized agriculture continues to shape land use. In general, the political economy of agriculture reinforces greenhouse gas emissions and constrains farmers' abilities to participate in mitigation. For example, production oriented policies and programs can inhibit farmers' willingness to respond to climate change (Lewandrowski and Brazee 1993; Reilly 2011). Government programs to protect farmers from loss may also allow farmers to remain unconcerned about climate change (Reilly et al. 2003). In addition, once a farmer has invested capital in a particular production regime, it may be difficult to change, even with incentive programs. Lastly, agri-food corporations benefit from the current system and will continue to use their political power to inhibit responses to climate change (Reilly 2011). In addition to the pressures related to contract production, these other structural factors will continue to play out and shape farmers abilities to respond to climate change.

Conclusion

As more resources are devoted to education and incentive programs to encourage climate change mitigation in agriculture, additional research is needed to investigate the extent of structural barriers and how they inhibit participation and the evolution of a climate change ethic. In cases where a few companies control commodity markets, climate change mitigation programs will likely need to engage in a dialogue with these companies in order to garner farmer participation. Another avenue would be to pursue structural changes in the agri-food sector through creating and enforcing anti-trust laws that would break down concentrated power and

open up markets for producers (Hauter 2014). In this case, if a farmer believes strongly in environmental or climate stewardship they could decide to contract with a company that did not impose standards that discouraged the adoption of environmental practices. As concentrated markets exist for a wide range of commodities (Constance and Heffernan, 1991; Stuart 2009; Hauter 2014), dissolving this power throughout the agri-food sector would allow more room for agricultural producers to choose to adopt environmental practices and develop new ethical positions, such as a climate change ethic. A further option includes contract reform, possibly restricting competitive aspects of agricultural contracts and/or limiting the amount of control allowed in production contracts. Without addressing these structural constraints it is unlikely that farmers will be able to dramatically alter their practices to reduce greenhouse gas emissions. We therefore conclude that efforts focusing on farmer education alone will remain largely ineffective. These efforts need to scale up their attention to address structural barriers that inhibit responses to climate change and the evolution of a climate change ethic.

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