A QUALITATIVE ANALYSIS OF THE PERCEPTIONS OF IOWA CORN FARMERS REGARDING ALTERNATIVE ENERGY USAGE AND A PROPOSAL FOR POLICY CHANGE

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Chapter I

Introduction

Problem Statement

Fossil fuels have helped fuel the world for over 100 years and have been an indirect cause of large population increases. A fossil fuel is defined as a fuel, such as coal, oil, or natural gas, formed in the earth from plant or animal remains (Merriam Webster, n.d.). The future holds many challenges directly associated with discovering alternatives that can support our human population of 7 billion and increasing. The agricultural industry is a prime example of an energy-intensive industry. Unfortunately, the world supply of oil accounted for today is only expected to last a mere 40 to 50 years from now (Pimentel and Pimentel, 2008; Goldemberg, 2007). In order to maintain current food production in the future, a switch to alternative sources of energy is necessary. The purpose of this study is to analyze the perceptions of corn farmers in Iowa regarding the use of alternative energy sources in their farming practices.

Corn is one of the fifteen crops that compose almost 90% of the plant calories/protein consumed by humans (Pimentel and Pimentel, 2008). The average American consumed 28.4 pounds of corn in 2000 (USDA, 2000). Corn is used in a number of different products that most Americans either consume or use on a daily

basis such as soda pop or soaps and cleaners. Iowa, the state with the most corn production, harvested more than 2.37 billion bushels of corn (Iowa Corn Growers Association, 2010a). In order to provide information relevant to the implementation of strategies to switch to alternative sources of energy within the corn industry in Iowa, a qualitative analysis was conducted with corn farmers in Iowa to determine their attitude towards using alternative energy.

Objectives

Through personal interviews with corn farmers from Iowa (most of them involved with the Iowa Corn Growers Association), three research questions were explored.

1. What background influences have played a role in current views of farming practices?
2. What type and how much nonrenewable energy do the corn farmers use on their farms annually?
3. What are the farmers' perspectives regarding the use of alternative sources of energy?

Each research question was examined through a variety of questions which are included in Appendix A of this study.

Relevance

Agriculture is a highly energy-intensive practice using energy both directly, as fuel or electricity, and indirectly, in the form of fertilizers and chemicals used in farming practices. If an oil crisis were to occur prior to finding alternatives for both the direct

and indirect energy usages, the agricultural industry would suffer tremendously and a food shortage would follow. According to the Environmental Protection Agency (EPA, 2009), corn and soybeans are the two largest crops grown in the United States with corn bringing in the most revenue, $15.1 billion in 2000. In 2000, the United States produced 43.5% of the world's corn and the corn grown in the U.S. accounts for almost one quarter of the harvested crop acres in this country. If corn production decreased dramatically not only would corn products be affected, but livestock production would also see a significant decrease because "almost eighty percent of all corn grown in the U.S. is consumed by domestic and overseas livestock, poultry, and fish" (EPA, 2009).

By understanding the views of Iowa Corn Farmers regarding alternative energy usage, a proposal could be developed to decrease fossil fuel usage through alternatives that the farmers would be more likely to accept. The government has a tendency to make policies that the general public may not necessarily agree with, and this is a perspective that could be avoided. This study employs interviews to determine the perceptions of Iowa corn farmers towards the adoption of alternative energy sources and provides generalized information that could be useful in the process of finding and implementing alternative policies.

Methods

This research is based upon a qualitative method that employs interviews to acquire data. Interviews conducted in person allow for exploration of the farmers' attitudes toward the use of alternative sources of energy in their practices. There are a

number of corn grower associations in Iowa that corn farmers can join. Prior to travelling to Iowa to conduct the interviews, the Iowa Corn Growers Association (ICGA) and the Practical Farmers of Iowa (PFI) were contacted via email to select a group of farmers willing to participate in this study. I was told that there would be a meeting for ICGA in mid-January 2011 and that I would be able to interview a number of farmers that day. Unfortunately, PFI was unable to set up interviews in a group setting and I was only able to interview one farmer from PFI. Every interview took place in a group setting with the exception of the single farmer from PFI. Each interview was recorded and transcribed by self-selection. Self-selection transcription allows the researcher to transcribe everything of importance while leaving out details that are not considered important for the research. The transcriptions were then printed out and analyzed for themes that are discussed in the results section of this study.

Groups Studied

IOWA CORN GROWERS ASSOCIATION

The Iowa Corn Growers Association (ICGA) is focused on implementing policy to increase profitability for corn farmers in the state of Iowa. One of the largest issues for ICGA is promoting ethanol-friendly policies. Education on the importance of sustaining the corn industry and education concerning ethanol practices and the importance of producing ethanol to relieve the strain of oil in the United States are the two main focuses of ICGA, as stated in their website. “The ICGA works to protect existing markets for Iowa corn, and promote the expansion of new ones. ICGA also works to affect state and federal

policy on renewable fuels, increase support for Iowa's livestock industry, and promote trade policies that are fair to Iowa corn growers" (ICGA, n.d.). In all, by supporting policy for renewable fuels, ICGA is working to increase profits for the ethanol industry indicating the possibility that the farmers in this organization might lean towards the renewable energy spectrum.

PRACTICAL FARMERS OF IOWA

Practical Farmers of Iowa (PFI) was founded in 1985 and consists of approximately 2,400 farmers and friends of farmers. The group has recently developed a policy committee, but works mostly with community relations and farmer-to-farmer networking. This, they say, allows for the farmers to collaborate with one another and promote sustainable farming practices (Practical Farmers of Iowa, n.d.). PFI has developed a number of different projects for members. The field crops program focuses on improving the quality of product and decreasing the environmental effect of producing corn, soybeans, small grains, alfalfa, red clover, and other perennials. The group is working to document the energy used among different farming systems by allowing farmers to measure on-farm energy use and then assess where they can decrease it throughout the year. The office for PFI is located in Ames, Iowa, which is ideal due to the fact that this is in Story County where over 200,000 acres of corn are produced annually.

Chapter II

Literature Review

Energy independence has become a hot topic throughout America over the past few decades. The United States is extremely dependent on foreign oil, with imports accounting for over 65% of the oil used in the United States. With 90% of U.S. oil deposits already depleted, the U.S. will become even more dependent on foreign oil in the coming years if a change is not made (Pimentel and Pimentel, 2008). The problem with depending on foreign oil is that the U.S. is forced to maintain civil relationships with the countries that provide the oil regardless of any other circumstances. Approximately 48% of the crude oil imports to the U.S. come from countries associated with OPEC: Algeria, Angola, Ecuador, Iraq, Kuwait, Nigeria, Saudi Arabia, and Venezuela (U.S. Census Bureau, 2011). Relationships with some of these countries have become strained over the past decade. As relationships continue to decline in integrity, oil prices will continue to rise.

Unfortunately, foreign oil is a smaller problem when considering the larger problem of diminishing sources of oil worldwide (Pimentel and Pimentel, 2008; Goldemberg, 2007). A study conducted by the German military that was accidently leaked warns of an economic crisis in a mere 15 years as a result of peak oil. This study

states that there is "'some probability that peak oil will occur around the year 2010 and that the impact on security is expected to be felt 15 to 30 years later"' (Rudolf, 2010). As the oil is depleted the U.S. will have to switch over to coal and various renewable energy sources to supply its energy needs. The problem with this switch is that coal supplies are only projected to last approximately 50-100 years (Pimentel and Pimentel, 2008). The agricultural sector in America is an extreme example of fossil fuel usage in America; it accounts for 17% of all of the energy used in the U.S. today. To feed each American, approximately 400 gallons of oil are used annually (Pfeiffer, 2004). Due to agriculture's dependence on fossil fuel, as the production of fossil fuel declines, the production of food will ultimately decrease as well.

There are two types of energy sources on a farm: direct and indirect energy as described in the introduction. In 2002, direct energy usage on America's farms accounted for a mere 1% of the total energy consumption in the U.S. (Schnepf, 2004). This indicates that direct energy is not where the focus of this research should be. The largest amount of energy usage on the farm is with indirect energy costs with fertilizers and pesticides. Approximately 75-90% of the cost of production of nitrogen-based fertilizers is used for natural gas (Schnepf, 2004). According to Schnepf, "[i]f fertilizers and pesticides were divided into their natural gas and petroleum components, the total direct and indirect consumption of natural gas would amount to over 26% of total energy consumption in the agricultural sector" (2004). Consequently, while direct energy consumption also needs to be decreased the main decrease in energy needs to come from fertilizer and pesticide usage.

Fertilizers are used to introduce nutrients into the soil that are essential to growing crops. On average, since 1991, 20 million metric tons of fertilizer is used annually by U.S. agriculture (ibid). Nitrogen-based fertilizers make up 56% of this usage while potash and phosphate make up for 24% and 21% respectively (ibid). Nitrogen has become a rare commodity in the U.S. similar to that of oil. The U.S. imports much of the nitrogen used for fertilizers specifically from Canada and more recently Middle Eastern countries (ibid). This could potentially cause problems similar to the problems associated with foreign oil mentioned earlier in the review.

Nitrogen-based fertilizers are highly energy dependent (natural gas accounting for 75-90% of production costs). Although corn does not require as much nitrogen fertilizer per acre (~130 lbs/acre) when compared to other fruits and vegetables such as tomatoes (~205 lbs/acre) or potatoes (~220 lbs/acre), the amount of corn acres harvested is substantially larger than any other crop discussed in Schnepf's study and therefore uses more nitrogen fertilizer overall. According to Schnepf, wheat and corn dominate nitrogen usage with corn using approximately 5,000,000 tons of fertilizer annually (2004). For corn, the direct and indirect energy costs differ significantly. Out of the total energy costs on the average corn farm (26.5% of the overall production costs), 6.6% of this cost goes towards direct energy while 19.9% goes to indirect energy usage (7.5% to chemicals and 12.4% to fertilizers) (ibid). Again this is indicative that by decreasing the usage of nitrogen-based fertilizers and chemicals on the farm, there will be a significant decrease in energy usage.

Economics of Agriculture

Although agriculture is still a highly energy intensive process, the energy input has greatly decreased since the agricultural boom of the 1970s. Direct and indirect energy usage has decreased by 26% and 31% respectively since the late 1970s due to increases in efficiency and technological advances that increased yield while decreasing input (Schnepf, 2004). This decrease was also due to the high oil prices in the late 70s. These large increases in oil prices have started to occur again. In 2007, oil prices skyrocketed to levels never seen before. In turn, fertilizer prices doubled from 2006 levels, seed prices went up 30%, and the price of chemicals rose 12% (Armah, Archer, & Phillips, 2009). These increases have caused the price of food to drastically increase as well. Surges in corn prices have also occurred. Some studies state that this price increase is due to increases in biofuel production. According to Armah et al.'s study, between April 2007 and April 2008, 10-15% of the increase in food price was due to biofuel production and 36% of this increase was due to increased energy costs (Congressional Budget Office 2009; as cited in Armah et al. 2009:333). These conclusions lead to the idea that as better technologies are introduced and there is a decreased dependence on fossil fuels price, fluctuations will be much less apparent.

The focus of this study is on corn production in Iowa. The reason Iowa was chosen for this study was because in 2007 corn contributed $8.3 billion to Iowa's income and Iowa alone produced 2.37 billion bushels of corn (ICGA, 2010a). The economics of corn production in Iowa must be examined to determine the effect on the

economy of Iowa if production were to slow down due to petroleum and/or natural gas shortages. In 2007, agriculture related industries accounted for 27% of Iowa's total economy. The agriculture industry accounted for 331,880 jobs, or approximately 11.1% of the estimated population of Iowa in 2007 (ICGA, 2010a; USCB 2009). This data indicates that if an oil shortage were to occur, the economy in Iowa would plummet. Corn production would begin to slow drastically and food prices would surge. This would cause an overall downturn economically across the nation and world, and could ultimately cause mass destruction, food shortages, and starvation. In order to prevent this from happening an analysis must be conducted on possible alternatives that already exist that could replace conventional agriculture technologies.

How to decrease energy usage on the farm

Sustainable agriculture was defined by Congress in the 1990 "Farm Bill" as "an integrated system of plant and animal production practices having a site-specific application that will, over the long term (FACTA, 1990):

- Satisfy human food and fiber needs;
- Enhance environmental quality and the natural resource base upon which the agricultural economy depends;
- Make the most efficient use of nonrenewable resources and on-farm resources and integrate, when appropriate, natural biological cycles and controls;
- Sustain the economic viability of farm operations; and
- Enhance the quality of life for farmers and society as a whole."

Some sources believe that industrial organic farming is not sustainable in today's time. Yields have increased drastically with the introduction of GMOs, mechanization, and chemical inputs. In 1920 U.S. farmers were producing 30 bushels of corn per acre, but on average in 1999 the yield was 134 bushels of corn per acre. This is almost a 450% increase in yield due to industrial agriculture inputs (Horrigan, Lawrence, & Walker, 2002). Fortunately, there are a few changes the average farmer can make to reduce energy usage in the farm and practice more sustainable agriculture. By employing crop rotations, cover crops, and no-till and/or low-till farming practices a farmer can greatly decrease the energy input on his or her farm. A crop rotation is when two or more crops are rotated in a field to reduce the need for pest control and potentially reduce the amount of fertilizer needed for the crop (ibid). Preventing soil erosion is a crucial step in maintaining nutrients in the soil. Cover crops can help protect the soil from erosion. Some cover crops, called leguminous crops, also add nutrients to the soil (Pimentel et al. 2008). Soy is an example of a leguminous crop and Iowa corn farmers commonly employ corn/soy crop rotations. No-till and low-till farming systems employ the concept that with fewer disturbances to the soil the nutrients and water in the soil will remain (Horrigan, et al. 2002). All of these practices decrease the usage of fertilizers and fuel on the farm for machinery.

Pimentel et al. (2008) predicted that the energy used to produce corn could be reduced by more than 50% by:

- Using smaller machinery and less fuel;

- Replacing commercial nitrogen applications with legume cover crops and livestock manure; and
- Reducing soil erosion in corn production through alternative tillage and conservation techniques.

Another way to decrease the energy input in food production is to eat less meat. The majority of the livestock grown today are grain-fed. It takes much more energy to receive the grain through livestock when compared to eating the grain directly (Horrigan, et al. 2002; Pimentel et al. 2008).

Most industrial farmers do not consider organic farming a viable option due to the high labor requirement and lower perceived yields. Approximately 1,200 hours of labor per acre are required to raise corn by hand while modern technologies require only 11 hours of labor to grow the same acre of corn (Feeding the World 2002; as cited in Pimentel et al., 2008). A project called the Sustainable Agriculture Farming Systems at UC-Davis has conducted research showing the comparisons of industrial farming to organic farming yields (Clark, Horwath, Shennan, & Scow, 1998). The results of the study showed that the organic and low-input systems had crop yields comparable to conventional industrial practices in all crops tested including corn. The study also indicated that animal manure and cover crops used instead of synthetic nitrogen fertilizers resulted in an increased soil organic matter and the storage of nutrients. This indicated that the organic farming practices could have long-term fertility benefits for the soil (ibid). Clark et al.'s study is not the only study that had these outstanding results. The Broadbalk experiment, a farming systems trial at Rodale Institute, and a

number of other studies have been conducted to analyze how organic farming practices measure up to conventional practices. All of the results show indicate that organic farming practices produce similar yields to conventional farming practices (Vasilikiotis, 2011).

In 2007, a controversial study was released out of Michigan stating that organic farming could feed the world. Researchers at the University of Michigan found that yields were practically equal when comparing conventional and organic farms. The researchers also found that there was no need for increasing cultivated land when farming organically, since the same yields could be produced on the same amount of land as conventional farms. They were also able to dispute arguments that there are not enough "green" nitrogen sources by stating that sufficient nitrogen could be provided by planting cover crops between growing seasons. The researchers indicate that they believe that it is completely possible to feed the world with organic agriculture (*Science Daily,* 2007). At first glance organic farming seems extremely unreasonable to be practiced at large-scale. But, it is likely that in the 1920s no one imagined that in 1999, 134 bushels of corn could be produced on one acre. With new technologies in organic farming the prospect of going "oil-free" on the farm is becoming clearer.

Ethanol?

While switching to industrial organic farming seems viable at the moment, the extra labor on the farm would be significant. What if the tractors on the farm could run on ethanol? About 90% of the ethanol produced in the U.S. is a derivative of corn (Oliveira, Vaughan, & Rykiel, 2005). Brazil has employed a sugarcane ethanol program

and is a prime example of sustainable ethanol production. In Brazil, approximately 4.8 billion gallons of ethanol is produced annually from sugarcane and little to no competition for land use between food and fuel has been observed (Goldemberg, 2007). When comparing ethanol produced from corn or sugarcane, the ratio of renewable output to fossil input is 10.2 for sugarcane and 1.4 for corn. Goldemberg states that sugarcane is a more sustainable method to producing ethanol (ibid). Although sugarcane may be more sustainable as a whole, corn ethanol could be quite useful for replacing the oil dependency of corn farmers in Iowa. According to the Iowa Corn Growers Association, Iowa's ethanol industry can produce more than 3.27 billion gallons annually (2010a). In 2002, an estimated 1.1 quadrillion British thermal units (Btu) were used as direct energy in the U.S. agricultural sector. One gallon of ethanol is equal to 76,000 Btu (Schnepf, 2004). This indicates that approximately 1.45×10^{10} gallons of ethanol is required to fuel all of the direct energy usage in the agricultural sector in the U.S. Consequently, the state of Iowa needs to produce approximately 11.23 billion more gallons of ethanol to produce the amount needed to replace all of the liquid fuel needs for agriculture in the U.S. This number is a quite positive result due to the fact that Iowa is not the only state that produces ethanol. With further production of biofuel and ethanol throughout the country the entire agricultural system could be revamped by employing industrial organic practices combined with mechanized equipment running off of ethanol and/or biofuel.

The next step is to analyze the perceptions of alternative energy on the average Iowa corn farm. This analysis would help us to understand how the agricultural industry

could “Go Green” by switching to alternative methods of farming. The hope is high that with proper research the state of Iowa can be the leading example of alternative farming practices in America. The corn industry can and will surpass the negative impacts of an oil crisis on America’s agriculture.

Chapter III

Methodology

This study is based upon the use of a qualitative method that employed interviews to acquire data. The questions that comprised the interviews addressed three main topics. Those topics included background influences on farming practices, the farmers' current energy use on their farms, and the farmer's perspectives regarding the adoption of alternative sources of energy in their farming practices. Fifteen farmers from the Iowa Corn Growers Association (ICGA) and one farmer from the Practical Farmers of Iowa (PFI) were interviewed. The interviewees were included within one group and broad themes consistent among the farmers were analyzed as to represent a general ideal among Iowa corn farmers. The application of these questions in a qualitative manner should further expand the knowledge of how Iowa corn farmers feel towards the introduction of alternative sources of energy in their farms and what ways this should be pursued without causing unnecessary social unrest.

Sampling Procedure

First, an internet search was conducted to determine the best way to find a reasonable number of corn farmers to be interviewed. A few different organizations appeared in the search including the Practical Farmers of Iowa (PFI) and the Iowa Corn Growers Association (ICGA). Each group was contacted via email. The email explained

the purpose of the thesis and asked if any of the farmers in either organization would be interested in interviewing with me. I found out from my contacts with ICGA, that they were having a meeting that many corn farmers from across the state would be attending in January. I was informed that I would be able to interview at least seven farmers from ICGA if I attended this meeting as well. From my contacts with PFI, I received confirmation from one corn farmer that I could interview the same day I was going to work with ICGA at their meeting.

I conducted the interviews at ICGA in two separate groups in a conference room. One group consisted of eleven farmers while the other group had four farmers interviewed at the same time. The farmer from PFI was interviewed individually at a restaurant in Des Moines, IA. This separation will be taken into account, but in order to avoid error all farmers will be grouped as a whole to represent specific themes. The group interviews both took approximately an hour and fifteen minutes to conduct while the single interview took approximately thirty minutes. A consent form was produced, explained, and allowed to be reviewed by the participant in order for the participant to understand the purpose of the interview and any liabilities that may accompany this study and the assurance of confidentiality. The participants were made aware of the fact that they were audio taped and that the tapes were only to be heard by me. The consent form is included in Appendix B for reference.

Sample Characteristics

The only factor that determined who would be chosen for this research was the stipulation that they were directly involved in the corn farming industry as farmers. A total of sixteen farmers were interviewed for this study and they are all directly involved with corn farming practices in Iowa. Special attention was not given to gender, race, sex, age, or class for this sample, but those factors were taken into consideration as the data was analyzed. Of the sixteen farmers interviewed, two were female. Ages ranged from forty-one to sixty-one years of age. The average age of the participants was 54 years of age. Every participant considered themselves to be Caucasians.

Analysis Technique

After the interviews were completed, the audio tapes were transcribed by means of self-selection. This method allows for the interviewee to have the freedom to choose what part of the interviews should be transcribed to be included in the study. This allows for topics that end up being irrelevant to the study to be discarded during transcription. The transcripts were read and placed into patterns and themes. During the transcription, names were changed using pseudonyms so that anonymity can be maintained. At some points the farmers spoke freely without constraint or names attached to their words indicating that at some points during the transcription the name of the individual speaking was unknown. The transcriptions are included in Appendix C for reference. The audio recording was deleted immediately after transcription. Each

transcription was repeatedly read to ensure all information was included. Each farmer also filled an information form out in its entirety during the interview to allow for contact in the event that more information was needed than what had been transcribed. Participants were notified that they could request a copy of the study once completed.

Chapter IV

Findings

BACKGROUND INFLUENCES THAT HAVE PLAYED A ROLE IN FARMERS' VIEWS ON FARMING PRACTICES

Out of the sixteen farmers interviewed for this study, fifteen of them were members of the Iowa Corn Growers Association while one of them was a member of the Practical Farmers of Iowa. Every farmer interviewed came from a family of farmers and has been farming for at least 23 years. Every farmer involved in the study considers farming their primary occupation. The level of education of the farmers interviewed ranged from high school to a masters degree with 50% of the farmers obtaining a minimum of a bachelor's degree. The location of their farms ranged across the state with most coming from the northeast corner of the state. Figure 1 shows the distribution of where the farmers currently farm across the state of Iowa. Four of the farmers interviewed farm in counties that according to ICGA's website harvested over 200,000 acres of corn in 2007 (Jasper, Clinton, and Fayette counties, purple circles). This figure also shows which counties in Iowa harvested over 200,000 acres of corn in 2007 (red circles) (ICGA, 2010a). Therefore, this study covers many different areas of the state and the distribution of interviewees represents much of the state of Iowa.

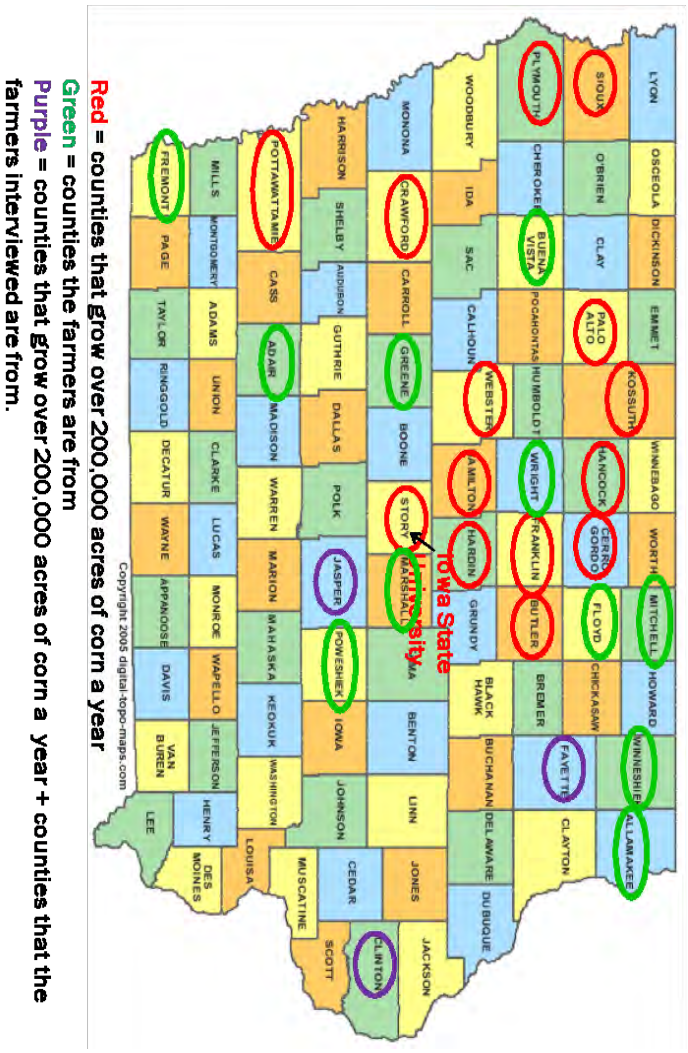

Figure 1: Representation of the state of Iowa and the counties that grow over 200,000 acres of corn annually (red circles), the counties that the farmers interviewed from this study farm in (green circles), and the counties that both grow over 200,000 acres of corn annually and that the farmers interviewed from this study currently farm in (purple circles).

ENERGY USAGE ON A TYPICAL CORN FARM TODAY

In order to come to reasonable solutions capable of transforming the Iowa corn farming practices to reduced fossil fuel, a better understanding of the energy usage by Iowa corn farmers today is needed. A few different factors will be discussed including the size of the corn farms, what each farmer grew their corn for, the different tillage

practices used in the farms, fuel usage, and pesticide and fertilizer applications. These factors will help us to better understand how much energy is actually used in the farming practices and what approaches can be taken to help Iowa corn farmers in the transition to less energy-intensive practices.

The first factor analyzed was the size of the corn farms of the farmers interviewed for this study. Corn farm sizes ranged from 425 to 2100 acres of corn plantation. The average size was 1160.9 acres of corn per farm while the median was 850 acres of corn. These results differed quite a bit from the values given online for the average corn farm size. According to the Iowa Corn Growers Association, the average Iowa corn farm in 2002 was 222 acres or corn (ICGA, 2010b). This indicates that this study dealt with corn farmers with much larger fields to harvest than the average corn farmer. Ultimately, this can be used as an advantage because if a solution can be developed that is economically feasible for the farmers in this study, then this same solution could be easily applied to smaller farms.

The next factor analyzed focused on where the crop grown goes after harvest for each farmer interviewed. Are there different perceptions towards alternative sources of energy for farmers that grow for feed versus ethanol production? To my dismay, the majority of the farmers did not grow for a specific use. One farmer stated *"We grow enough for all uses."* The other farmers agreed with this statement. Some of the farmers grew specifically for export due to their proximity to the Mississippi River. One farmer even grew his corn for production of dog food. ICGA did a presentation showing what

the corn grown in Iowa was used for in 2009. Table 1 shows what was produced from the corn grew in 2009 in Iowa according to ICGA. It is shown that the majority of the corn grown in Iowa (44%) goes towards ethanol production.

Table 1: Representation of what the corn grown in Iowa in 2009 is used to produce (ICGA, 2009).

2009 Iowa Corn Crop	
What the corn is used to produce	**Percentage**
Processed into food for human consumption	15.6%
Exports	15.5%
Livestock Feed	24.9%
Ethanol	44.0%

A factor that had not originally been considered was the different tillage practices and the effect of these practices on the environment. The soils on farms contain large amounts of organic matter. When the soils are tilled this organic matter is released in the form of carbon dioxide. By reducing how often or intensely the soil is tilled, the organic matter is able to stay in the soil and greenhouse gas emissions are decreased. Many farmers have begun to switch to no-till or reduced-till practices due to possible incentive programs being considered in the cap-and-trade policies that would pay the farmers for this switch (Horowitz, Ebel, & Ueda, 2010). In the interview each farmer was asked what type of tillage is used on their farms. Five of the farmers interviewed for this study explained that they practice no till for the majority of their farms and only till certain sections such as where the fertilizer is applied. Figure 2 shows the tillage practices used by the farmers interviewed. According to the USDA there are

two types of tillage systems: conservation and conventional tillage systems. For this study, the individuals that practiced no till, reduced till, minimum till, conservation tillage, and mulch tillage will be included as part of the conservation tillage systems. With this grouping, approximately 83% of the farmers interviewed followed a conservation tillage practice. Any tillage system that maintains 30% or more of the surface of the soil with crop residue after planting is following a conservation tillage system. A conventional tillage system is any system that leaves less than 15% crop residue after harvesting (Ali et al., 2000).

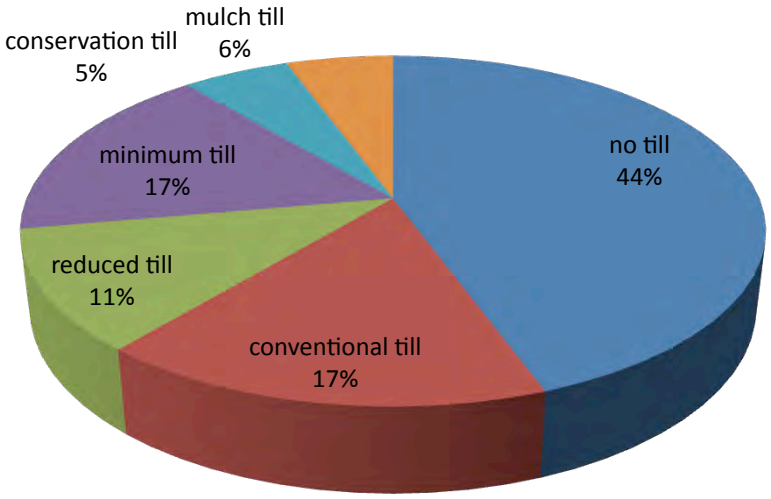

Figure 2: Representation of tillage practices used by the farmers interviewed for this study.

Seventeen percent of the farmers interviewed for this study use conventional till for at least a portion of their farming. Only three farmers stated that they only use conventional tillage on the farm. The total number of corn acres for all of the farmers interviewed is equal to 18,574 acres. The three that stated they only use conventional

tillage have a total of 4900 acres that are conventionally tilled. An energy estimator provided by the USDA that calculates how much fuel will be used for each tillage practice in the Iowa region was used. For 4900 acres of corn, approximately 24,402 gallons of diesel fuel are used annually for conventional tillage. If the farmers were to switch to mulch-till (a form of reduced till) approximately 6,223 gallons of diesel fuel (26%) would be saved. If the farmer were to switch to no-till there would be a 44% savings from conventional till and a savings of 10,829 gallons of fuel (USDA, 2008). Therefore, as the farmers switch from conventional tillage to conservation tillage systems there would be a large reduction in fuel usage.

In order to understand how the farmers could switch to an alternative energy source in their farms, questions were asked that focused on their energy use today. Many of the questions asked in the interview were very specific concerning the usage of fertilizers, pesticides, and other chemicals in the farms. The farmers were unable to answer these questions due to the specificity and I was directed to Iowa State University to conduct this research. I contacted Iowa State University and was directed to a database created by the USDA from the annual Agricultural Resource Management Survey (ARMS). The ARMS database states that for 2005, the state of Iowa grew an estimated 12,802,748 acres of corn. Of these acres 94.232% were treated with some type of pesticide, 17.668% of acres were treated with some type of insecticide, and 94.083% of acres were treated with some type of herbicide. The database estimates that 141.242 pounds of nitrogen, 64.255 pounds of P_2O_5, and 82.586 pounds K_2O are applied per treated acre annually (USDA, 2005). Many negative environmental impacts

have surfaced in recent decades such as diminished drinking water quality from nitrogen and eutrophication from phosphorus contained in the surface water (Christensen, 2002). Per acre approximately 5.5 gallons of fossil fuel is used for fertilizers (Manning, 2004). For Iowa this is equal to a little over 70.4 million gallons of fossil fuel to fertilize the land to grow corn. According to the ARMS report 15.8% of a farm's cost is to buy commercial fertilizers and chemicals while 5.1% goes to fuels and oils and 1.8% goes to utilities (USDA, 2008). These percentages are out of a total cash expense of $164,490 per farm which indicates that approximately $8,000 worth of fuel and oil is bought annually to power a farm.

One limitation in this study is the lack of data concerning how much renewable fuel sources are already being employed in the farms. One farmer noted that "Most if not all of us have used biodiesel as a partial source of our diesel fuel." Practically all of the farmers said that they use E10 fuel (10% ethanol/90% gasoline) in all of their vehicles. Some of them even use E85 (85% ethanol) in their machinery while one farmer uses virtually 100% biodiesel or ethanol. The USDA did conduct an on-farm renewable energy production survey in 2009. A total of 48 farms in Iowa reported use of wind turbines with 39 farms having small wind turbines (1-100kW) and 9 farms having large wind turbines (>100kW). A total of 40 farms in Iowa reported use of photovoltaic and/or thermal solar panels. The population of this survey were all that selected yes on the 2007 Census of Agriculture to the question "At any time during 2007, did this operation generate energy or electricity on the farm using wind or solar technology, methane digester etc.?" This study indicates that there has been an increase in renewable energy

usage by Iowa corn farmers since 2000 with the majority of the renewable energy placed between 2005-2009 (USDA, 2011). A direct question concerning renewable energy usage on the corn farm was not asked, but the farmers did state that they practice “green” agricultural practices.

Although farmers are beginning to use more renewable energy in their farming practices, the average price for installing this energy is high. For the state of Iowa, the installation cost on average per turbine is $23,480 for a small turbine. Approximately, 29% of this cost is funded by outside sources (USDA, 2011). The 2002 USDA Farm Bill Section 9006 created a program that helped agricultural business fund more energy efficient projects. In 2003, about 113 projects were funded by the USDA under this provision with the majority of the funding going to large wind and bioenergy projects (Union of Concerned Scientists, 2008). It is possible that the farmers receiving outside funding could have received funding through this bill, but there is not sufficient evidence that the passing of this bill directly correlates with the increase in the use of renewable energy in Iowa.

PERSPECTIVES REGARDING ALTERNATIVE ENERGY ON THE FARMS

Although I knew how involved Iowa was in the ethanol industry, I was unaware of the extent to which the farmers were willing to use green agricultural practices. Every farmer interviewed for this study participates in green agricultural practices such as crop rotations or using as little fossil fuel as possible (fertilizers, pesticides, fuel, etc.). One unnamed farmer from ICGA said, “*We are always looking for more economical and*

green ways to grow the crop." He went on to explain that most farmers have begun using precision application to apply their fertilizer, pesticides, etc. In this study, there was no one practicing organic farming and none of them planned to become an organic farmer in the near future. One of the unnamed farmers from ICGA stated that there will be "*9 billion people by 2050 – if we were all organic farmers people would have to choose who is going to live and who is going to die*."

Everyone in this interview group seemed to agree with this statement. One unnamed farmer from ICGA said that his "*operation operates for profit. If that profit potential is there I would be organic. Currently I am not organic and probably won't be*." The consensus was that organic farming is not economically feasible because the yield is not as high and there is not a large enough market for organic farming. According to the second group of farmers interviewed from ICGA, many farmers grew all food grade corn prior to the high price of oil. But, the farmers pay for the transport to the cities that process the corn and it has become expensive. To add to the problem, hybrids (genetically modified organisms) have not kept up for the food grade corn compared to the corn grown for animal feed and ethanol. Consequently, the farmers grow more for ethanol and livestock feed production than for food-grade.

A few common themes existed when asked questions concerning feelings towards alternative energy usage. For the first interview with eleven farmers from ICGA, everyone began discussing as a group their feelings towards alternative energy. Many times there was not a name attached to the quote due to a group discussion; therefore,

many of the quotes included will have an unnamed farmer attached to the quote. There were three overpowering themes in the discussion among all of the groups interviewed from ICGA.

1. Genetically modified organisms (GMOs) are viewed as extremely positive and useful among all farmers.
2. Every farmer is very willing to use alternative energy on their farms.
3. Economics drives everything.

Overall, the consensus from the farmers from ICGA was that as technology becomes available the dependence on fossil fuel will steadily decrease. They also agreed that as the price of oil rises, more alternatives will surface and become useful to farmers. Why start using an alternative source of energy that is more expensive when there is no need to?

GMOs are positive and useful among all farmers

GMOs have become extremely controversial in recent years. GMOs have the potential to drastically increase yields of crops, increase the efficiency, and provide essential vitamins to food that people otherwise may have not received, such as iron (Food and Agriculture Organization of the United Nations, 2011). Unfortunately, the controversy exists because of the possibility of health problems among humans, the possibility of the transfer of the genes to the soil, and resistance to the modification by insects (Llaguno, 2001).

The farmers interviewed in this study gave the impression that they believed that GMOs are great because of the higher yield they are experiencing and the decrease in pesticide usage. The farmers seemed to agree with the statement that "*our yields are continuing to increase due to genetics and management on the farmer's part*." The farmers agreed that as they increased the usage of GMOs on their farms they would increase the yield for less labor. They discussed that as long as the GMOs remain economically feasible there would be no reason for them to not use them. They also explained that as the yields continue to grow with use of GMOs, there is less energy used on the farm which not only decreases their costs, but also decreases their use of fossil fuel.

Every farmer in this study is very open to the use of alternative energy

Every farmer interviewed seemed to agree that the farmers in Iowa are very open to the possibilities of alternative energy. The majority of the farmers are already involved with ethanol production due to the fact that many of them grow corn that goes to the ethanol industry. One farmer interviewed in the first group of ICGA farmers stated:

> I think most of us are open to possibilities that are there. Some of them seem a bit ridiculous, maybe they're not. I would say when you live in a place like Iowa we've been open to other possibilities and experiments.

All of the farmers in this group agreed with this statement, but noted that while they may be open towards greener agricultural practices they do not need to be forced into it. They unanimously agreed that they do not want government intervention. One unnamed farmer from ICGA thought that we simply need to "*Slow down the environmental whackos*." This perspective was interesting because the one farmer from PFI (Practical Farmers of Iowa) felt that changing policy slowly would be the only way to alter the energy usage among the farmers. From my perspective, I feel that if the farmers were provided incentives to switch to alternative sources of energy they would not feel that this was a form of government intervention. Rather, they would view it as an opportunity to switch to alternative energy on their own accord.

A surprising response from the farmers occurred concerning the problem in the United States of becoming energy independent. One farmer stated:

> Most of us think that the most important thing our government is trying to get done is to make America energy independent – that way we don't have to send our brightest and youngest to other parts of the world to keep the damn oil flowing in and buying it from people that would rather kill us. – Unnamed Farmer

Another farmer explained:

> We are really happy to be participating in alternative energy because me I have two kids. Would I rather raise corn to provide part of liquid fuel to fuel America or would I want to send my kids to defend some place in a part of the world that doesn't like us? – Unnamed Farmer

The consensus among the farmers was that by growing corn to produce ethanol they are directly decreasing America's energy dependence on foreign oil. They feel that it is

necessary to continue to do so and some believe that ethanol could be an answer to many of our problems in this nation concerning energy dependence.

Economics drives everything

> I think everyone is in favor of green practices as long as it is economically sustainable and to their best interests. We're in the farming as a business. We need to see what is going to work for us and what works for us may not work for others. – Unnamed Farmer

The final theme was by far the most dominant theme in all of the interviews conducted for this study. The farmers agreed that they live and die based on economics. If a resource, fertilizer, pesticide, seed, etc. is not economically feasible or they can buy something for a more affordable price they will do that rather than paying more for something to fit some ideal. When asked if they believe we can progress as a society dependent on oil, all of the farmers agreed that once the price of oil is increased drastically they will find a way to use alternative sources of energy to fuel their farms because at that point this would be a cheaper option. They do not believe that one day we will simply run out of oil. Rather, they believe as prices continue to rise there will be a slow transition towards alternative energy because this will be more economically feasible. Generally speaking, if there is an alternative out there that someone can prove will work and is financially viable then the farmers will use it. Regarding economic feasibility one farmer stated:

> We generally have the best soil and climate to grow corn. We look at economics. The bottom line is important to us, but we also look at what is renewable.

This theme agrees well with the data concerning the increased alternative energy usage over the past few years after the Farm Bill passed by the USDA discussed earlier. When incentives were provided to build wind turbines and solar panels, there was an increased interest in this production. I believe that this same theory can be applied to the farmers and their alternative energy usage. If incentives were provided, or subsidies, to increase the usage of alternative energy practices or increase the use of less energy-intensive practices ultimately the use of fossil fuel on the farm would decrease. This will be summarized in chapter five of this thesis.

Chapter V

Conclusions and Recommendations

One main theme of this study resonates when considering how one could potentially eliminate fossil fuel usage on the average Iowa corn farm – "Economics drives everything." Because the farmers are willing to switch to greener sources of energy as long as the options are economically feasible, an analysis must be conducted to identify feasible options. My recommendation is to introduce a bill that provides incentives for practicing greener agricultural principles similar to the Farm Bill that provided incentives to introduce renewable energy on the farm. An understanding of the current incentives provided to corn farmers must first be understood to determine how to fund additional projects.

Many corn farmers receive money annually from the government in the form of subsidies. There are two types of subsidies for corn crops - payments triggered by prices set by Congress in farm bills and direct fixed payments. When the price of corn drops below a level mandated by Congress, the government will pay money to the farmers. Direct fixed payments provide money to farmers regardless if the prices of corn increase or decrease (Norris, 2007). In 2005, over $20 billion was spent on farm subsidies and when Congress passed the Farm Bill of 2002 they stated that 52% of all subsidies will go to soybean and corn growers (*The Economist*, 2006). The current subsidies provided to corn farmers are expected to decrease due to the large increase in use of corn for

ethanol which increases corn prices and ultimately decreases the amount of subsidies provided to farmers (ibid).

On the contrary, in 1985 when Congress passed the Food Security Act, they "tied soil conservation practices to farmer eligibility for government-sponsored crop deficiency payments, crop loans, storage payments, federal crop insurance, and disaster payments" (National Research Council, 2010, p. 93). From 1990 to 2004, the number of planted crop acreage using conservation tillage practices rose from 26% to 41% indicating that the act passed by Congress worked to increase more sustainable agricultural practices (ibid). According to the National Research Council, there are a number of different factors to consider when increasing crop production while decreasing the detrimental effects agriculture has on the natural environment. By employing proper soil management practices such as conservation tillage and cover crop usage, the soil quality is increased allowing for decreased fertilizer usage. Crop diversity is also critical to soil quality and decreased erosion. The 2008 Farm Bill finally started to move in the direction of providing incentives to adopt organic production practices and even "mandates a five-fold increase in research funds for organic production with two research priorities: assessing conservation and environmental outcomes of organic practices and developing new and improved seed varieties for use in organic production systems" (National Research Council, 2010, pg. 293). The Organic Agriculture Research and Extension Initiative had an increase in funding thanks to the 2008 Farm Bill from $15 million to $78 million. "In 2009, the program received 134 proposals totaling $98 million but could only fund 28 of them" (Smith, 2010). Due to the

incentives provided to help organic farmers, the number of organic farms in Iowa has increased.

Due to preconceived notions that organic farming is not sustainable on a large scale, I believe that the 2012 Farm Bill should focus on decreased fertilizer usage by providing incentives to employ diversification of crops and increased usage of manure as fertilizer. In the Food, Conservation, and Energy Act of 2008 the USDA provided funds to analyze the effect of manure as a source of fertilizer. Only 5% of all cropland in the U.S. is currently fertilized with manure, with corn accounting for over half of this cropland (USDA, 2009). A little less than 12% of all corn acreage planted had manure applied to it. This is likely due to the fact that many livestock farmers grow corn on their farm to reduce the cost of feeding their livestock and apply the manure directly to the crop due to the proximity. From manure application per acre, corn receives approximately 140 pounds of nitrogen, 69 pounds of potassium, and 91 pounds of phosphorus on average. The main issue with manure as a fertilizer is the transportation issue. More than 80% of corn producers that apply manure to their farm produce the manure on the farm. The other problem with relying on manure as a fertilizer is that it may not have the correct combination of nutrients and minerals needed to produce the same yields as those from commercial fertilizers. On the contrary, due to the high nitrogen requirement for corn, corn farmers that used manure as fertilizer on their farm reduced, on average, commercial nitrogen fertilizer applications by 58% (USDA, 2009). Now the question lies in if there is a way to combine the natural manure fertilizer with another “green” practice to ensure sustainability?

A study funded by the Leopold Center for Sustainable Agriculture and the USDA found outstanding results combining both manure usage and crop rotations. Nitrogen fertilizer inputs were found to decrease 78% and herbicide usage decreased 85% when a 4-year rotation of corn-soybean-small grain/alfalfa-alfalfa hay was employed. In the three-year rotation of corn-soybean/small grain/red clover there was a 66% decrease and an 80% decrease in nitrogen fertilizer and herbicide inputs respectively (Cruse, Liebman, Raman, & Wiedenhoeft, 2010; American Society of Agronomy, 2010). The crop yields matched or exceeded the conventional system yields despite the large reductions in input. This reduction in fertilizer input combined with increased manure application as fertilizer created a 23% to 56% decrease in fossil energy usage when compared to conventional systems. The only downside to this crop rotations/manure usage was the increase in labor usage. When a four-year rotation was employed, 91% more labor was required when compared to the labor requirement of a two-year rotation, 41 minutes/acre per year (Cruse et al. 2010). In all, with proper subsidies and incentives the switch from the traditional two-crop rotation to a four-crop rotation would be extremely beneficial for both the farmer, considering possible higher yields and reduced cost, and for the environment.

In order to determine the feasibility of a policy change in Iowa and the respectability of the policy change among Iowa corn farmers I contacted the one farmer I interviewed from Practical Farmers of Iowa. He has been in the farming industry for over 30 years independently and grew up on a corn farm in Iowa. I explained to him how the previous research indicates that with increased crop rotation and manure

application there could potentially be a substantial decrease in synthetic fertilizer usage. He pointed out that I needed to determine the difference in gross revenue between the two, three, and four year crop rotations to determine how much of an incentive would need to be provided to the farmer to make this switch.

In a study conducted by Liebman et al. (2008), an analysis of a 3 and 4-year low-input system was conducted. The effects of a 2-year (corn/soybean) rotation with conventional fertilizer application, a 3-year (corn/soybean/small grain + red clover green manure) rotation, and a 4-year (corn/soybean/small grain + alfalfa/alfalfa hay) rotation were analyzed. Without subsidies the returns to land and management was 7.1% higher for the low-input 4-year system when compared with a 2-year conventional system. On the other hand, the 2-year conventional system, without considering subsidies, had 6.3% greater returns to land and management when compared to the 3-year low-input system. When subsidies were considered, the 4-year system only had 1.1% greater returns when compared to the 2-year system and the 2-year system had 7.9% greater returns when compared to the 3-year system. Economically, the 4-year system described by Liebman et al. proves to be the most sustainable (Liebman et al. 2008).

After analysis of the economic benefits of a four-year rotation compared to a 2-year rotation, a policy idea was constructed. My recommendation is to decrease the amount of corn subsidies provided to the average corn farm and reallocating those funds to an incentive program centered around the four-year crop rotation system described by Liebman et al (2008) and Cruse et al (2010). This incentive program would provide education materials focused on the transition to a four-year crop rotation

compared to the conventional 2-year rotation system to all Iowa corn farmers. The average corn farmer, due to the cut in corn subsidies, would receive a pay-cut. In the education materials, the farmers would be told that they could receive a fiscal incentive that would balance their income back to its original value or higher prior to the subsidy cut by transitioning to a 4-year low-input rotation system. In this bill, help would be provided to the farmers to assist them with this transition specifically due to the increase in labor. Ultimately, with incorporation of an incentive of this type there could be a potential decrease in fertilizer usage of up to 78% and a decrease up to 56% in fossil fuel usage.

The agricultural system today is highly energy intensive. As fossil fuel prices increase food prices increase causing a detrimental effect in the economy. If fossil fuel usage on the average farm was reduced substantially, this problem could be alleviated. The goal of this study was to analyze the perceptions of Iowa corn farmers regarding the acceptance of alternative sources of energy. The results showed that farmers are open to practicing greener agricultural practices as long as they are economically feasible. On the other hand, there was a general agreement that organic farming was not the answer. Therefore, this study concludes that crop rotations and use of manure as the main fertilizer could help to alleviate the dependence on fossil fuels among Iowa corn farmers. In order to promote this transition, a policy needs to be formulated that includes incentives to make this switch while cutting back on corn subsidies to further motivate the corn farmers of Iowa. To further this recommendation I would like to write an Executive Report and send it to Congress and the USDA for consideration in the 2012

Farm Bill. There could be detrimental effects if a transition to lower energy inputs is not taken prior to a fossil fuel crisis. I hope that this study provided clear insights into the views of the "average" Iowa corn farmer and their willingness to switch to greener agricultural practices. As one farmer stated – "Corn is the miracle crop of America" and work needs to be conducted to save it and America from tragedy.

Chapter VI

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Chapter VII

Appendix

Appendix A – Interview Questions

Demographics

Research question: *What background influences played a role in current views of farming practices?*

How old are you?
What is your race/ethnicity?
What is your highest level of completed education?
Are you from this area or a transplant from another region, state, or country?
How long have you been involved in the agricultural industry? In the corn industry?
Is farming your primary occupation?
Do you come from a family of farmers?

Farm Practices

Research question: *What type and how much nonrenewable energy do the corn farmers use on their farm already?*

Are you an organic farmer or plan to become one in the near future?
What do you grow your corn for? Food, animal feed, ethanol?
How large is your corn farm?
Approximately how much fertilizer do you use annually for your corn production?
Do you by chance know the brand of the fertilizer that you use?
Could you describe your pesticide usage specifically for corn?
Would you say that you participate in "green" agricultural practices such as using less fertilizers and pesticides or crop rotations?
Approximately how much diesel and gasoline do you use annually for the machinery on your farm?

Acceptance to switching over to alternative energy

Research Question: *What are the farmers' perspectives regarding the use of alternative sources of energy?*

Do you believe that we can continue to progress as a society dependent on oil? If so, do you believe that we will ever hit a point where we cannot use fossil fuel to continue in society?
What would it take for your workforce to switch over to no use of fertilizers or pesticides?
Would you be willing to consider using alternative fuels in your machinery, possibly even ethanol produced from your corn?
How do you feel about alternative energy and "green" agricultural practices?
Is there anything that could be done to change your perspective on alternative energy and "green" agriclutural practices?

Concluding Questions

Do you feel there is anything I left out that you should mention regarding the issues we discussed?

Appendix B – Consent form for the Institutional Research Board

Consent Form for research of Iowa Corn farmers' acceptance of alternative energy

Researcher Name: Danielle Faurie
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Affiliations: Texas State University – San Marcos, TX

The research for this project is being conducted in order to write an undergraduate thesis. The research is a qualitative analysis of the social acceptance of alternative sources of energy for agriculture in Iowa, the state that has the largest corn output.

You have been selected to be interviewed because you are directly involved in corn production in the state of Iowa. By understanding your level of social acceptance for alternative sources of energy, we can help to determine what would be the best step of action for your geographic area if an oil crisis were to occur. This interview will be conducted in person. I have obtained funding from the University Honors Department at Texas State University from an undergraduate thesis grant to travel to Iowa.

To my knowledge there are no physical or psychological risks to you, the participant. Participation in this interview process is purely voluntary and participants may withdraw from the study at any time without any repercussions. Pertinent questions about the research participants' rights, and/or research related injuries to participants should be directed to the IRB chair, Dr. Jon Lasser (512-245-3413) or Ms. Becky Northcut, Compliance Specialist (512-245-2102). Questions directly relating to the research being done should be directed to Danielle Faurie (254-624-8034).

Unless otherwise states you will remain anonymous within the thesis. In the thesis and further publications your name will be replaced and all quotations will be anonymous. The raw interview data will be kept until the thesis is finished in May, 2011. All tapes from recorded interviews will then be destroyed. The revised interview data will be published on eCommons at Texas State University and as an article with a scholarly journal. If requested I can send you a copy of the finished thesis to have knowledge of all findings. The IBR application number for this research is 2010N4054.

By signing the following you consent that you have read the above form and that all questions pertaining to the research has been answered by the researcher in full.

Participant: _____

Researcher:_____

Appendix C – Interview Transcriptions

Group 1:

First Research Question:

Farming is everyone's primary occupation

Questions: Age, race, education, county, length of being involved in agriculture industry, come from a family of farmers?

Farmer 1 – 51, white, Bachelor of Science Iowa State, Allamakee county, 29 – corn, yes

Farmer 2 – 41, white, Bachelor of Science Agriculture Iowa state, Fayette, 25 – corn, yes

Farmer 3 – 49, white, Bachelor of Science, Iowa State, Mitchell, 30 – corn, yes

Farmer 4 – 53, white, some college, Poweshiek, 35 – corn, yes

Farmer 5- 60, white, three years in Farm Op Iowa state, Wright County, 50 – corn, yes

Farmer 6 – 56, white, three years Farm Op Iowa State, Buena Vista, 56 – corn, yes

Farmer 7 – 60, white, three year diploma RN, Floyd, 38 – both, six generation

Farmer 8 – 61, white, teacher cert Ag education, Iowa state, Marshall, 50+ - both, yes

Farmer 9 – 42, white, high school, Winneshiek, 23 – corn, yes

Farmer 10 – 49, white, BS agronomy Purdue, Wright, 25 – both, no – city people (actuaries)

Farmer 11 – 53, white, farm management, Freemont, 45 – both, yes

Second research question:

Everyone grows their corn for everything – ethanol, food, etc. "When we plant we do not plan for a specific end use in mind." "We grow enough for all of the uses."

The consensus was that the farmers both rented and owned their land – not one or the other.

For the fertilizer question - *"none of us apply more fertilizer than we need to."*

"That is the most efficient and probably safest meaning of any pesticide usage. GMOs have for the consumer as well as the farmer – we don't have to handle a chemical as we farm."

Everyone in the room used GMOs on their farm.

Everyone in the room participated in "green" agricultural practices such as crop rotations, etc.

Diesel and gasoline usage – depends on the year.

"In a conventional farming practice about 8 gallons of diesel fuel for tillage per acre."

"Most if not all of us have used biodiesel as a partial source of our diesel fuel."

In order to go to no fertilizer we would have to choose who lives and who dies. *"More genetic in our crops will enable us to grow as much or more corn per acre with less input."*

Would you be willing to consider using alternative fuel in your machinery? – Already run all of the *machinery on biodiesel*

"We are evolving towards more green practices but we don't need to be forced into it."

"I think everyone is in favor of green practices as long as it is economically sustainable and to their best interests. We're in the farming as a business. We need to see what is going to work for us and what works for us may not work for others."

Why not on organic farming? Been there done that – did not like that it takes a lot more labor. The market is slim to none. *"9 billion people by 2050 – if we were all organic farmers people would have to choose who is going to live and who is going to die."*

Everyone is okay with using alternative energy on their farms.

"We are really happy to be participating in alternative energy because me I have two kids. Would I rather raise corn to provide part of liquid fuel to fuel America or would I want to send my kids to defend some place in a part of the world that doesn't like us."

"As technology becomes available we feel good to produce a part of what America needs for its fuel supply plus growing food and doing it all at the same time."

"Most of us think that the most important thing our government is trying to get done is to make America energy independent – that way we don't have to send our brightest and youngest to other parts of the world to keep the damn oil flowing in and buying it from people that would rather kill us."

"One of the things we always hear in the food and fuel debate is that it is an either/or debate and it's not an either/or debate. When you get done making ethanol out of a bushel of corn you have 1/3 of the physical bushel left. In pounds of protein you end up with the same amount of protein left after producing the ethanol. This protein can go to the livestock feed."

"Our yields are continuing to increase due to genetics and management on the farmers part."

Questions: organic farming? How large is your corn farm? Classification of corn farm? Tillage usage? Do you believe that we will ever hit a point where we will run out of oil?

Farmer 1- no, 900 acres, individually/family owned, no till, no we cannot continue to be dependent on fossil fuels

Farmer 2- no, 800, individually/family owned, conventional till, no

Farmer 3- no, 2100, family corporation/partnership (farm with brother and dad one has a corporation), conventional till, think we are going to continue to use some fossil fuels because we will find other liquid energy sources

Farmer 4- no, 600, individually/family owned, reduced till, mix of a little bit of everything as we progress

Farmer 5 – no, 850, individually/family owned, reduced, no

Farmer 6- no, 700, individually/family owned, no till, continue a blend of fossil fuel, lots of fossil fuel and alternative energy, our dependence will keep gradually lowering

Farmer 7 – no, 750, family and partnerships, conventional, no till, and minimum till, agree with Farmer 6

Farmer 8- no, 750, family corp and individual, no till and minimum till, will continue to use fossil fuels, thinks we have a lot of fossil fuel. "Slow down the environmental wackos."

Farmer 9 – no, 1700, family partnership, minimum till, no

Farmer 11 – no, 2000, family corp, conventional till, same perspective as others

Farmer 12 – no, 600, family owned, no till, no

Group 2

Everyone was part of a family farm

Farmer 12 – 59, white, trade school, Jasper county, most of my life, farming is the primary occupation, no organic, grows corn for animal feed or sweetener he also grows corn for his hogs that he contract feeds (he doesn't own hogs, but he feeds them via his corn), grows 400-450 acres of corn. Individually owned. For weed control we use precision application and use the minimal amounts that will give us the desired results. When it comes to insecticides we only spray when we need to. The fungicide would apply mostly to corn on corn and the usage varies year by year. Yes (to the question of "green" agricultural practices) *"We are always looking for more economical and green ways to grow the crop."* Half of the corn acres would be no till (corn/bean rotation), a fourth of the corn acres is continuous corn and they do a conservation

tillage. He uses a minimal amount of fuel for the operation they do – doesn't take a lot to drag the sprayer.

Do you believe that we can continue to progress as a society dependent on oil? If so, do you believe that we will ever hit a point where we cannot use fossil fuel to continue in society?

I don't know what the future is. I think that we will utilize the resources that are available to us. I think that if we get to the point that we are pretty sure we will run out of oil we will find something else. Particularly in the US we have another carbon resource out there – we have a huge abundance of coal. We hear about electric vehicles – most are coal powered. Wind does provide a certain amount of energy, but it is not dependable. We need other sources. Our ingenuity and enterprenurship we will continue to grow with the resources we find.

Farmer 13 – 63, white, ongoing (1 degree), Jasper county, when he was 14, farming is the primary occupation, no organic, grows corn for animal feed or corn sweetener but a good share go out to export to the continental US. They have a market that goes out to a great number of people. Has 2000 acres of corn and is considered average size.Lots of 50/50 rotation – corn and soybeans. Continuous crop is harder to grow than rotation crops. Family partnership and individually own land. We use as little as we can. Atrazine or glycophate would be the base for the pesticide. (to the question of "green" agricultural practices). Use a lot of no till and with continuous corn they do do some tillage. Generally minimal or no till. Over the years the fuel usage has steadily decreased. Every tractor that you have purchased in the last 30-40 years has had a better per acre usage. Fuel doesn't stick out as a major usage anymore. Less fertilizer and pesticides means that we have dramatically dropped the per acre usage for petroleum there.

Do you believe that we can continue to progress as a society dependent on oil? If so, do you believe that we will ever hit a point where we cannot use fossil fuel to continue in society?

Generally speaking, if there is an alternative out there that someone can prove will work and is financially viable we'll use it. We've always taken the point of view that we need all we can get. We're open to interpretation because we are all users of energy. He does believe that we can continue to progress as a society dependent on oil. He does not think that we will ever hit a point where we cannot use fossil fuel to continue in society. It's the ability to deliver the fuel at an affordable price. When we are forced to do something we will adapt as a species. When they don't pay, we don't do it. ALL ABOUT ECONOMICS. Let's use what works and don't find reasons why it won't work.

Farmer 14 - 60, white, ongoing (1 degree), east Central Iowa, Clinton county, started as a youth and started farming on his own after college, farming is the primary occupation, no organic, proximity to Mississippi river and has several elevators for export and also has a wet mill (corn processing mill) and he also sells a large amount of corn to a dog food plant. Robert's export goes to international export rather than domestic. Currently 2500 acres of that 1600-1700 in corn. The rest is soybean. Family operation. We apply less than the amount that the

manufacturer has approved. Sometimes we have found that we can cut our rates to less than what they say due to insect and weed pressure. If the need isn't there we can cut or eliminate things. Apply a low rate of pesticide. In farming career we have gone from a conventional tillage program and cycled through to reduced tillage and now no till/and strip tillage. The majority of his field is not tilled. Only till a narrow band that they apply fertilizer nutrients and seed. Because of this they have been able to cut their fertilizer use very much. Fuel usage would be less than average. Does all of the spraying himself – have the technology to where he doesn't overapply. Envision a field that is not perfectly square – in the past used to have overlap. Today, the equipment allows for no overlap because it knows what has been applied and what hasn't been applied and when you cross over to an area that you have already applied it will stop.

Do you believe that we can continue to progress as a society dependent on oil? If so, do you believe that we will ever hit a point where we cannot use fossil fuel to continue in society?

I don't think farmers as a whole have a particular agenda. It's all about utilization of resources. That's why we are at the point that we are today. The resources we had in the past brought us to this point. We will continue to use the resources that are available to us. If oil becomes less available and higher in price we will switch away from those. To some extent, he believes that we can continue to progress as a society dependent on oil. As the price goes up, the laws of economics will progress this. Only if we don't have government intervention – that is something he is afraid of. We don't want extraneous forces coming in here and telling us that we have to follow a certain way. Can we get by without oil? – No, not entirely. We can use less, but we have the technology either here or coming that we can make most of our oil products out of corn. He can't shift away from oil – dozens of engines that he can't just turn the switch and say I'm going to use something else. Will we bring in alternative energy in in any way we can? – Yes, as it's available and economic.

Farmer 15 - 48, white, high school, Odair county, 31 years, farming is the primary occupation, no organic, supplies to an animal feed mill and ethanol plant, 1800-2000 acres of corn. Individual and family operation. All pesticides are non-restrictive. Primarily glyphosphate. Using less fertilizer per bushel of corn than they did in the past. Primarily no till.

Do you believe that we can continue to progress as a society dependent on oil? If so, do you believe that we will ever hit a point where we cannot use fossil fuel to continue in society?

Farmers are very much for alternative energy. Groups of farmers in his area putting up windmills. Farmers perceptions are very positive concerning alternative energy usage. Depending on the avenue that you take we can or cannot continue to progress as a society dependent on oil. Ethanol, biodiesel, we can use animal fat to make biodiesel – all can be used to replace the oil. He believes we could go totally renewable. Could use livestock waste for fertilizer needs. With new technologies we have corn oil.

Do you already use biodiesel in your machinery?

Farmer 12 – pickup is E85. Wish he had a blender pump because he would use a higher rate of ethanol than the 10% in his other vehicles. He uses biodiesel when it is economical. We currently run on B5 (5% bio) as our base. His son-in-law turns cooking oil into diesel and runs his vehicles on that.

Farmer 13 – virtually 100% biodiesel or ethanol. Some of the lawnmowers or chainsaws may not have the right engine to run these products.

Farmer 14 – uses ethanol in everything including small engines (10%). The biodiesel he uses it most of the time except in the cold of the winter. But the number of gallons he uses in the wintertime is miniscule compared to the summertime. Low sulfur diesel fuel now and the pumps are wearing out – add 5 or 10% biodiesel and the lubricity is added back in and the equipment lasts longer.

Farmer 15 – we use E10, E85, and use biodiesel.

Everyone uses GMOs – not exclusively though. It still comes down to an economic decision.

the farmers really don't like the classification concerning the part/tenant/etc. ownership and what kind of farm they have – individual, family, corporation etc.

"We generally have the best soil and climate to grow corn. We look at economics. The bottom line is important to us, but we also look at what is renewable."

"A lot of our opponents never factor in the co-products of our ethanol plants. They think ethanol is the end-product."

"If you consider all of the fossil fuel that gets consumed when making a gallon of gasoline and you look at growing a bushel of corn and turning it into ethanol our efficiency is better."

"The dry mill plants are only 10-15 years old. We are continually increasing our efficiency."

"In our dry mill plants the only thing we utilize is starch. I ask people is your diet short of starch? And they say , uhh.. no. I still have all of the minerals, oil, proteins, and the fiber to utilize after making the ethanol."

According to the farmers, there is a strong opposition towards ethanol because of the pure economics of it. They think that others are ticked off that the business is moving to Iowa and not staying in their state – such as Texas being mad that the cattle business is moving back to Iowa and Nebraska.
"We're all about utilizing our biggest energy resource. And that's sunlight. That's why we grow corn. Because corn is a huge vacuum concerning sunlight."

"Corn is the miracle crop of America"

Already have natural derived pesticides – through GMOs.

Cellulosic will be a factor for alternative fuel. If it were available and it is economic we would use it. We live and die economics. That's a lot of our philosophy as well – economics.

We use a lot of electricity – mostly coal powered, but some is natural gas.

According to this group, ICGA is the home base for ethanol production.

The farmers can use GPS and pinpoint where they need the fertilizer. There is also autosteer that allows for more precision when driving and less gasoline usage per acre.

They wanted to comment on the oil usage – not like the last group.

*"We put on what is roughly scientifically analyzed that it needs to grow a certain amount of bushels on the amount of soil and what is termed economically feasible." (*concerning fertilizer) Fertlizer usage is purely economically.

What they used concerning pesticides is marginal compared to years and years ago because of hybrids, etc. Biotech engineering has changed the amount and types of pesticides we use.

"We use nothing restrictive and nothing that would run off into groundwater. We are strictly contact."

Very farmers own all of the land, but very few don't own some. So a lot of farmers will grow their corn, but won't own all of their land.

"*Before the high price of oil we were all food grade and shipped of all of the freight to Kansas City."* The farmers pay for their transport to these cities and growing food grade corn has become too expensive due to the cost of oil and the hybrids have not kept up for the food grade corn compared to the corn grown for animal feed and ethanol.

"Most of the farmers you will see are of Northern European descent."

"I think most of us are open to possibilities that are there. Some of them seem a bit ridiculous, maybe they're not. I would say when you live in a place like Iowa we've been open to other possibilities and experiments."

"Farmers tend to be worldly focused."

"My operation operates for profit. If that profit potential is there I would be organic. Currently I'm not organic and probably won't be."

Third group (one person) – Farmer from Practical Farmers of Iowa (PFI)

Farmer 16

58, white, bachelor of science in agricultural business started a masters in economics, Farm in Greene County and is originally from Iowa, He grew up on a corn farm and started farming in 1979, farming is primary occupation, come from a family of farmers. He is not an organic farmer and does not plan to become one. He grows corn for everything – food, ethanol, animal feed, etc. His son and him have 2000 total acres, but not all corn. He has 850 acres of corn and his son will have 300-400 acres of corn this year. Individually family owned by him and his son. He owns his share and his son owns his. Use glysophate and atrizine and he just changed pesticide because he is trying to avoid resistance to glysophate. He does participate in green agricultural practices – his crop rotation is corn, corn, soybean. He does grow alfalfa and has set wetlands aside. He uses mulch till ? (two passes with tools, sets tillage equipment to try to maintain 60-70% corn residue after a corn crop and 30-40% residue after a soybean crop).

Do you believe that we can continue to progress as a society dependent on oil? If so, do you believe that we will ever hit a point where we cannot use fossil fuel to continue in society?

Believes cannot continue to use petroleum. Possible to continue to use other sources of fossil fuel, but not without damaging our environment to the extent that we will not be able to survive as a species.

What do you think would be a viable option for Iowa Corn farmers if any?

We need to conserve a lot more energy – can do that by modifying crop rotation. Very simple change would be to go from corn, soybean, and small grain. As evidenced by the research of Matt Liebmann at Iowa State University. We would really reduce our need for pesticides and fungicides and insecticides, reduce our need for phosphate or nitrogen based fertilizer.

What would it take for your workforce to switch over to no use of fertilizers or pesticides? Or switch to natural fertilizers and pesticides?

Probably take a change in policy and regulations. Probably would have to say that we can't use unnatural fertilizers and pesticides. Government policy drives economics. Have a societal problem with too much regulation so would have to have a small change rather than a large change.

Would you be willing to consider using alternative fuels in your machinery, possibly even ethanol produced from your corn?

Yes – thought about using soybean oil for his tractors (because they are diesel). We could use alternative sources of energy. Not sure if ethanol is efficient and not sure if biodiesel is efficient. Biooil through the pyrolisis method could be an option. He is willing to look into other sources of energy – just needs to be efficient for the particular usage he would be doing.

How do you feel about alternative energy and "green" agricultural practices?

Thinks we have to become far more sustainable than we are today. Depleting fuel and fossil fuel resources.