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A CRITICAL EXAMINATION OF SUSTAINABLE AND CONVENTIONAL FARMERS AS THEY NAVIGATE CLIMATE CHANGE

A Thesis in

Geography

by

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Abstract

Do sustainable and conventional farmers have a differing perception of climate change? This research explores sustainable and conventional farmers, focusing on vegetable growers, concentrating on several counties in Northeast Pennsylvania, and how they are thinking about and managing for climate change. This qualitative research was conducted through structured interviews conducted over a year and a half period. A semi-structured interview script was created and the farmers contacted to set up one hour interviews. Both groups feel that they do not know what explicit preparation for climate change would entail but feel that their management of climate risk will probably aid their adaptation. Sustainable farmers rely upon soil health and productivity for climate change adaptive strategy. Sustainable farmers are doing many management practices that may enhance their autonomous adaptation success. Conventional farmers involved in contracts with various agricultural companies may find their autonomous adaptation ability constrained.

Climate change, sustainable agriculture, risk society, autonomous adaptation

Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction and Literature Review

The global climate is changing. Human emissions of greenhouse gases and wide-spread land-use change are causing the worldwide mean temperature to increase, accompanied by an increase in the frequency and intensity of extreme climate events such as heavy precipitation events and periods of drought and heat waves (Carter, 2007)(IPCC, 2007: Summary) . These changes will substantially impact agriculture, necessitating adaptation (Easterling et al., 2007). The impacts on agriculture will be complex, such as the increase in crop yield due to the fertilization effect of increased CO_2 balanced against negative impacts of heat and drought conditions (Easterling et al., 2007). Decades of research have achieved a greater understanding of the vulnerability of production-based agriculture to climate change. Research on alternative types of agriculture has largely ignored the challenge of climate change, focusing instead on broad comparison with production-based agriculture (Goodman, 2000). A previous study concludes that the connection between sustainable agriculture and climate change adaptation strategies is a gap in the literature that needs to be better understood (Wall and Smit, 2005). Research is needed that assesses the vulnerability of sustainable agriculture to climate change. Just what constitutes sustainable agriculture is open to wide interpretation. Because this thesis research focuses on a region in Pennsylvania, I will use a local definition for sustainable agriculture. According to the Pennsylvania Association of Sustainable Agriculture (PASA):

> *"Sustainable agriculture* means building farms that can sustain healthy soil, produce healthy food and be profitable. Sustainable agriculture seek[s] to be environmentally and socially responsible…strives for harmony with the natural environment, while considering human health as well as societal and economic well being (www.pasafarming.org)."

My research tests the hypothesis that sustainable and conventional farmers have divergent perceptions of, and adaptive management practices for, dealing with the influences of climate variation and change on their own production systems. This hypothesis is prompted by conflicting research findings in the literature with respect to attitudes of conventional versus sustainable farmers toward environmental stewardship. This hypothesis is important to test because the results will provide greater insight into the processes by which both groups will adapt to climate change. In the United States and other post-industrial nations, sustainable agriculture is growing in terms of area and financial importance. One component of sustainable agriculture is organic farming and there has been a 20 percent increase in organically certified land in the United States since 1989 (Bruinsma, 2003).

This chapter introduces the thesis research and situates the work within a larger body of literature while showing why the research question merits close inspection. It provides an overview of the project, including definitions of important key concepts. Then it will give a brief literature review on the three bodies of scholarship that this thesis draws from;

vulnerability, agriculture and climate, and perception of climate change. It concludes with a section that places this work within a theoretical framework by examining connections with the 'risk society' (Beck, 1992). This research borrows conceptually from vulnerability analysis (adaptive capacity and sensitivity in particular). It also builds from existing qualitative work which will be elaborated in the next chapter on methods.

1.1 Sustainable and Production-Based Agricultures

The distinction between sustainable and conventional or production-based agriculture is contentious. One writer refers to agriculture in North America as having a "bipolar organizational structure" because of these two diverse types of farming (Thompson, 2001). Conventional farming is normally defined as a system that emphasizes maintaining and increasing productivity by the application of yield-enhancing technologies and the high volume use of many inputs such as fossil energy and chemicals (pesticides, synthetic fertilizers). This type of agriculture became prominent in the early twentieth century as a utilitarian means of creating large quantities of cheap food for a growing working class (Thompson, 2001). The terms *production-based* and *conventional* agriculture are used interchangeably in this thesis.

Alternative forms of agriculture were prompted by acknowledgement of risks to the environment and human health resulting from certain potentially destructive or hazardous cultural practices associated with

production-based farming. This acknowledgement was accompanied by an emerging viewpoint that farming without the use of synthetic additives achieved by reliance on supporting natural systems was philosophically stimulating (Thompson, 2001). "Sustainable agriculture" is primarily a self-label, although the United States Department of Agriculture (USDA) does have a definition and a set of suggested guidelines for what that constitutes. The PASA definition primarily emphasizes the soil (environment), healthy food (product) and economic viability. Throughout my research I will use the term sustainable agriculture, viewing organic agriculture as a specialized subset[1].

The experience with the development of sustainable agriculture has shed light on other large-scale problems. Scares of food supply contamination such as mad-cow disease caused consumer mistrust and interrupted global trading practices. Food supply scares have pushed consumers toward wanting local and organic products (Enticott, 2003). After the Mad-Cow related food scare, European countries moved toward requiring product labeling proving "product traceability" that was adopted from pre-existing organic agriculture practices (Whatmore, 2002). This reinforces the notion that sustainable agriculture fulfills an important

[1] To what degree a farmer is truly practicing sustainable farming and the similar debate on the effects of national organic certification and 'organicness' (Guthman, 1998) are important issues but will only be touched on briefly to clarify definitions.

component of the market and provides a useful resource for policy alternatives.

McCann et. al.'s (1997) comparison between organic and conventional farmers suggests that organic farmers tend to be more willing to take on short-term risk for long-term productivity of the farm. Their research indicates that both groups are concerned with long-term productivity of their farms but that conventional farmers focus primarily on maintaining yearly yields in order to stay economically viable while organic farmers focus primarily on a wider range of goals involved in keeping their organic certification, some of which involve sacrificing short-term yield. Thus organic farmers must tradeoff a certain degree of profitability with general increases in long-term soil-productivity. This research seeks to delineate possible differences between practitioners of conventional and sustainable agriculture in their ability to create meaningful short-term changes on the farm. Such changes are posited to help create long-term resiliency if they are advised by sound climate change research and policy.

Another study on agricultural risk points out that while organic farmers are eligible for crop payments through the Agricultural Risk Protection Act of 2000, the payment reflects the price of conventional products without the additional markup that an organic product may expect in the market (Hanson et. al., 2004). At the same time, subsidies that protect against loss from climate variation may actually decrease the financial motivation to make changes to protect against climate variation (Bryant et.

al., 2000). It follows then that the organic farmers have a greater financial motivation to protect their farm from climate variation because of a lack of risk subsidies covering the actual value of their product. This difference in the economic effects of weather and climate may cause a difference in perception to the risk of long-term climate change between the two groups of farmers.

The USDA states that sustainable farmers aim to "make the most efficient use of non-renewable resources and on-farm resources to integrate, where appropriate, natural biological cycles and controls" (Gold, 2007). Climate is both an integral resource and risk to be managed, and when possible utilized. Rather than managing climate risk with costly technology, sustainable farmers elect to monitor the climate and make hands-on, farm-level changes. This also suggests a potential difference between the farmers.

This thesis research questions both practitioners of sustainable and production-based agriculture on a wide range of topics. The main research question of this thesis is: do sustainable and production-based farmers perceive climate variability and change differently? Furthermore, if significant differences are detected between the two, do those differences influence how they manage climate risk?

1.2 Vulnerability

The concept of vulnerability has been developed to identify and analyze the governing features of system sensitivity to environmental change. Literature on vulnerability, especially within geography, stems from work in environmental hazards and food security and more recently has been applied to problems caused by climate change. The Intergovernmental Panel on Climate Change (IPCC), part of the United Nations Environmental Program and the World Meteorological Organization, conducts regular comprehensive reviews of research on vulnerability to climate change that aim at being an objective resource for policy-makers worldwide (Parry et. al., 2007, i). Those reviews cover many different systems, from human to biophysical.

The IPCC states that "vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change" (Schneider et. al., 2007). Overall vulnerability is a concept that can be applied to various scales and within different contexts. "Vulnerability is a function of the sensitivity, adaptive capacity, and the degree of exposure of the system to climate hazards" (Schneider, 2001). This definition implies the sensitivity of a system after its ability to adapt to negative impacts of climate change is exhausted. Smaller scale, localized studies using the IPCC definitions provide support for the scale of this thesis project (see O'Connor et. al., 1999a).

Vulnerability is calibrated to a specific place and a specific social situation along a spectrum of risks. "The concept of risk, which combines the

magnitude of the impact with the probability of its occurrence, captures uncertainty in the underlying processes of climate change, exposure, impacts and adaptation" (Schneider et. al., 2007). Mitigation includes initiatives to reduce and ease the effects of a hazardous event (Cutter, 2000). In the context of my thesis research, part of the social and biophysical context which filters the risk is the way in which the farmers choose to identify themselves (sustainable or production-based) and manage their farms accordingly.

1.3 Vulnerability-Food Security

The Food and Agriculture Organization (FAO) of the United Nations state that "food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 2003) and will be used as the definition of food security. Researchers examining food security define *vulnerability as "an aggregate measure of human welfare that integrates environmental, social, economic and political exposure to a range of potential harmful perturbations"* (Bohle, 1994). This approach focuses on the environment and various human systems, often focusing on the household level (Stephen and Downing, 2001). Food security research integrates an understanding of dynamic social systems with concerns of spatially-differentiated food insecurity (Adger and Kelly, 1999).

1.4 Vulnerability-Climate Change

Food security researchers seek to understand the environmental and social determinants of reliable access to adequate quantity and quality of food primarily at local and regional scales. On the other hand, climate change researchers explore the dynamic influences of globalization and climate change simultaneously (O'Brien and Leichenko, 2000). A follow up study points out that there will be 'winners and losers' created by climate change occurring within the context of globalization (O'Brien and Leichenko, 2003). O'Brien and Leichenko (2003), drawing from theoretical work, point out that politics influence the magnitude of vulnerability to both climate change and certain negative outcomes of globalization such as environmental injustice. It is often the case that developing nations are not reaping the benefits of trade liberalization while at the same time lacking resources to prepare for climate change (O'Brien and Leichenko, 2003). Such is an example of double exposure, the term O'Brien and Leichenko (2003) use to describe the combination of threats from both globalization and climate change. Take, for example, Mexico, where globalization has shifted emphasis away from subsistence crops and toward water-intensive export-oriented cash crops, creating a potential for disaster if climate change increases drought conditions (O'Brien and Leichenko, 2000).

The IPCC's Fourth Assessment Report examines the vulnerability of agriculture (Easterling et. al., 2007). The report emphasizes the importance of tracking what impacts sensitivity across multiple levels from the local level

with disease outbreak and conflict up to policies that affect multiple scales (Easterling et. al., 2007). The above research paves the way to complex questions about the impacts of multiple processes on the future of agriculture. Embedded within the discussion of sustainable agriculture are questions about how to maintain viable small farms serving local communities within the broader context of globalization and climate change.

1.5 Agriculture and Climate

This section explores several key concepts related to the interaction of agriculture and climate. Specifically, the uses of historical and current analogs that mimic climate change effects on agriculture are reviewed because of relevance to this research.

Predictions about the impacts of climate change on agriculture have been developed from a combination of simulation models and analysis of past response to climatic variability. Smit (2001) argues that while the capacity for adaptation in agriculture in some instances is high, actual practice is uncertain and regardless of degree of success, will not occur without cost. Other research points to degrees of successful agricultural adaptation to climate change as being inequitably distributed among regions and populations (Downing, 2002). Moreover, the IPCC has found that the "multiple stresses, such as limited availability of water resources, loss of biodiversity, and air pollution, are increasing sensitivity to climate change and reducing resilience in the agricultural sector" (Easterling et. al., 2007).

The IPCC concludes that the combination of socio-economic development, expected deceleration of population growth, and agricultural mitigation can reduce the negative impacts on food security (Easterling et. al., 2007). Another researcher argues that the impacts from climate change on agriculture and food security will ultimately depend upon policy relating to the world's poor (Schmidhuber, 2007). Understanding the resiliency of agriculture to climate change warrants knowledge of the uncertainty of adaptation at a variety of scales. It also requires knowledge of the multiple stresses of biophysical challenges such as lack of water and lessening biodiversity, and the potential effects of economic and social development. All of these components depend upon a number of actors and changes with different scales. This brief literature review of adaptation of agriculture to climate change illustrates the complexity of studying the phenomena across multiple economic and geographic scales.

Agriculture is continually adapting to climate changes. My research focuses on how sustainable and conventional farmers manage current climate variation. Bryant, et al., (2000) explores the interactions of conventional agriculture and climate, finding that the use of current climate variation as an analog for climate variation is acceptable because "climatic change will be experienced via on-going variability in climatic conditions". The IPCC provides several examples of historic adaptations such as crop substitution and relocation and shows that agriculture is capable of adapting to large scale changes in climate (Easterling et al, 2001). The most recent

IPCC estimates suggest that crops will suffer greater losses from climate extremes than from changes in the average climate (Easterling et al, 2007). This lead to the assertion that the devastating losses suffered in Europe by the extreme drought and heat in 2003 serve as a preview of the potential effects of climate change (Easterling et al, 2007). In my research I use current climate variation and the extreme growing seasons of 2006 and 2007, one with drought and the other flooding, to question farmers on their management responses. I posit that lessons learned from farmers' experiences with those two growing seasons will shed light on how such farmers might respond to long-term climate change.

1.6 Perceptions of Climate Change

A production system's ability to adapt to climate variability is strongly influenced by a farmer's perception of climate risks (Bryant et. al., 2000) along with biophysical, agronomic and socioeconomic conditions under which the farming is being practiced (Gitay et. al., 2001). Risk perception implicates behavioral intentions such as environmentally friendly behavior and confirmation of governmental initiatives (O'Connor et. al., 1999b).

In a recent study of public perceptions of climate change, the American public was "somewhat concerned" about climate change but did not think the impacts would affect them personally to a strong degree and that climate change was not of a high national priority (Leiserowitz, 2005).

The study found pockets of people who felt that climate change was not a real phenomenon, but rather 'created' by environmentalists and scientists. Perceptions are particularly important because public opinion often directs government policy and initiative (Leiserowitz, 2005). This may be changing though with the increased media attention to climate change in 2007 and calls to awareness such as Al Gore's Oscar-winning *An Inconvenient Truth,* which, according to Reuters "is widely credited with helping shift U.S. public opinion on the need for urgent action to curb man-made emissions of greenhouse gases linked to global warming" (Gorman, 2007).

In another public perception article O'Connor et. al. (1999b) found that most respondents tended to take a moderate position on the strength of their belief in climate change and the willingness to voluntarily change behavior and support government regulation such as regulations to reduce greenhouse gas emissions. Those researchers also found that demographics were important. Women were more likely to support voluntary changes while educated, older men were more willing to support government policies. Prior knowledge of climate change was also a key predictor for strong belief in climate change. Overall, O'Connor et al (1999b) conclude that their "results show that risk perceptions and knowledge increase people's willingness to take steps that address environmental problems. Risk perceptions and knowledge, however, share the stage with general environmental beliefs and demographic characteristics." while conceding that it is not an absolute predictor for future behavior (O'Connor et. al.,

1999b). Sustainable farmers may have a set of environmental beliefs that direct them into choosing that mode of agriculture. These beliefs could influence their perceptions of climate change and their actual management practices.

Bryant et al (2000) found that farmers either felt skeptical about climate change or felt prepared to face climate change because of their "technological and management tool-kit" (Bryant et. al., 2000). Are these perception-based findings similar for sustainable agriculture, a group that is often skeptical of conventional technology (Kaltoft, 2001)? This question leads into the next section which brings social theory into play to indentify risks and groups responding to those risks in a way applicable to this research.

1.7 Risk Society

The relations between agriculture and climate change are illuminated using the theoretical foundations of post-modernity. Specifically, I situate this study within the theories of Ulrich Beck's *Risk Society* (1992). This discussion has two distinct components: 1) Climate change as a symptom of modernization and therefore a part of pushing toward post-modernity. 2) Sustainable agriculture as a part of reflexive modernization and an outcome of the risks posed by modernization.

Beck's work entitled *Risk Society* (1992) provides a bridge between social theory and environmental issues. Beck's basic premise is that the modern period, with its scientific and industrial developments, has inadvertently created the side-effects of risks and hazards that the current reflexive period is dealing with, describing our time with the phrase "risk society" (1992). The reflexive period reviews and deals with the symptoms and structures of modernity. Transitionally, "[t]hey are being expected to live with a broad variety of different, mutually contradictory, global and personal risks" (Beck, Giddens and Lash, 1994). Risks are created through actions and decisions made by humans (Matten, 2004), unlike the definitions used in hazards literature in which the risk can be a strictly natural disaster (Cutter, 1996). The risks caused by the modern period are global in scale like climate change or at a small-scale all around the world like radioactive waste.

Some risks to individuals are difficult to detect with our senses such as toxins in food. We depend on the science establishment to detect and monitor such risks. Individuals sometimes become skeptical of the scientific/technocratic realm that may have created risks in the first place yet they must depend on that realm for information and a solution to the problem, causing a loss in public trust causing a (Beck, 1992). "The discourse of risk begins where trust in our security and belief in progress end" (Beck, 2000).

Beck validates the importance of research that examines perceptions:

> "the *end of latency* [when hazards become visible] has two sides, the risk itself *and public perception of it*. It is not clear whether it is the risks that have intensified, or our *view* of them. Both sides converge, condition each other, strengthen each other, and because risks are risks in *knowledge*, perceptions of risks are not different things, but one and the same" (Beck, 1992, emphasis in original).

The risks that stem from the industrial age are often caused by a faulty set of assumptions about technology like the outcome of burning fossil fuels. Public perception grows as the risk itself becomes undeniable. With this basis for Beck's theory outlined, I now explore more specifically the ways that the theory illuminates this thesis research.

1.8 Risk Society-Climate Change

Viewing climate change as a symptom of modern society is logical because it is the product of fossil fuel emissions and other human actions (Beck, 1992). Most of the greenhouse gas emissions largely responsible for climate change come from the developed world,[2] yet the effects will be felt globally and may cause significant problems within the vulnerable developing world. This is what Beck refers to as the "boomerang effect" (Beck, 1992; Bulkeley, 2001).

[2] While the developed world's greenhouse gas emissions have led us to the present condition with regard to climate change, the projected future emissions will largely come from the developing world including India and China both of whom have ratified the Kyoto Protocol but under terms that do not mandate emissions controls (Conti, 2008).

Decision-makers who create policy measures regulating or mitigating the causes or potential outcome of risks are distinct from their intended subjects who must accommodate those policies, who do not have a voice, and must deal with the consequences of risks.

In Demeritt's (2001) article on construction of climate change, he points to Beck's work stating that the reliance on climate change *science* to make the invisible visible is characteristic of the modern risk society. Demeritt goes on to explore the political nature of the assumptions embedded in climate change modeling, pointing out that few people beyond the scientists creating the model can understand the way it was created yet the results determine much focus in policy and further research. The public relies on interpretations of data that can be manipulated by politicians and special interests groups, causing a deeper distrust. Inversely, Demeritt examines how climate change scientists are themselves part of social interactions and the conception and classification of their data are filtered through their social understandings. His article is an example of exploring climate change through a social theory lens which aids in showing that the apolitical world of environmental science is deeply political, something that Beck points to as being a positive step forward (1992, 2000). At the same time Demeritt is critical of Beck's assumption that the lay-person cannot understand the basis of climate change science (2001). In this research I also try to examine the way farmers have created and classified information of

climate change for themselves and their own understandings of climate change for their farm and practices.

1.9 **Risk Society-Sustainable Agriculture**

The emergence of alternative agriculture in the United States developed from skepticism about the health of food and environmental degradation resulting from conventional agriculture (Thompson, 2001). "Solidarity from anxiety arises and becomes a political force" (Beck, 1992, emphasis in original). Kaltoft (2001, exploring the theories of Ulrich Beck) argues that the organic movement is mostly representative of transition to reflexive modern society through opposition to specific practices within conventional farming such as use of chemical pesticides and with an apprehension to science and technology. Industrial agriculture transfers risks such as exposure to chemicals, to the individual, farmers and those who eat their products. Sustainable farmers are trying to mitigate those risks while generating their own income. Yet sustainable farmers cannot escape from global climate change or large-scale environmental problems. This research will shed light on how sustainable farmers in this reflexive modernity, skeptical about scientific-agricultural experts and technology, express their perceptions about climate change and gain climate change related knowledge.

Chapter 2: Methods

This thesis research tests the hypothesis that sustainable and production-based farmers have a different perception of, and set of adaptive management practices for, dealing with climate variation and change. Its purpose is to understand how these two groups of farmers relate to and think about information on climate and climate change. The research design is qualitative in nature, using interviews to allow the farmers to speak for themselves through the lens of the observer/researcher. I strive for an objective comparison of sustainable and production farmers. This research yields a greater understanding of how farmers perceive the process of climate change adaptation by comparing groups and individual farmers within those groups in the same geographical region.

2.1 **Structure/Methodology**

To complete this research I interviewed both conventional and sustainable farmers within my study area. I then transcribed the recorded interviews. I analyzed the transcripts, looking for threads of commonalities and difference between the farmers. The process of analysis is iterative and rigorous. Figure 1 shows the process. The narrative results suggested themselves after this lengthy process of investigation. Before going into the specific methods used within this research, I will give background on qualitative methodology.

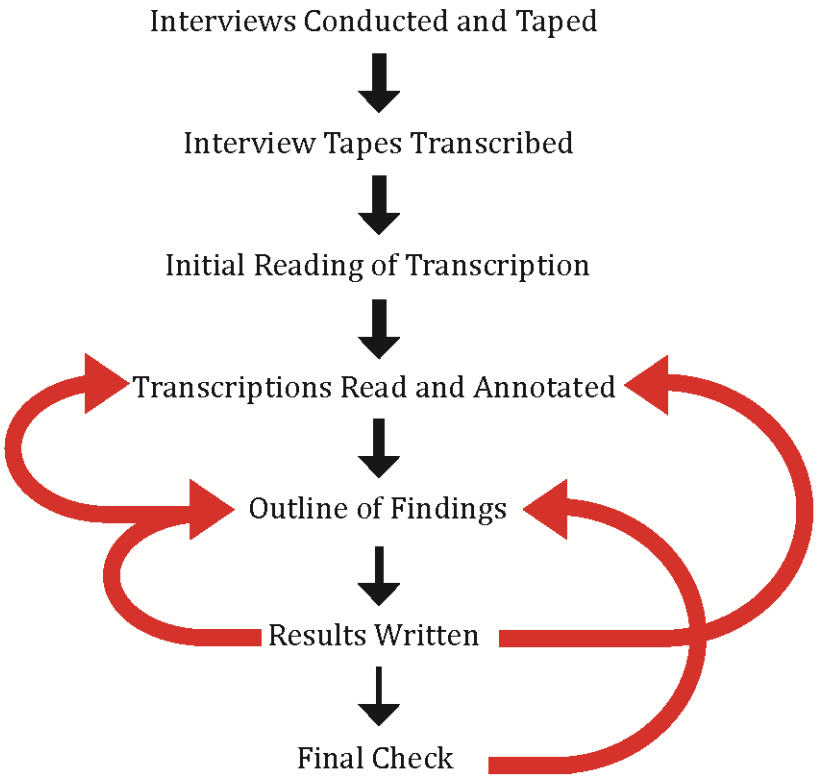

Figure 1: Process of Analysis

Several researchers, including Smit (1996), use primary data collection, including surveys of farmers, to better understand adaptation strategies with regard to current weather variability. My thesis is conducted using a primary data collection method that includes in-depth interviews with farmers. In the case of this thesis, the use of qualitative interviewing of farmers was deemed the best way to get reliable information regarding their perceptions of climate change both by asking direct questions about climate change and by examining how they interpret current climate variations in

their farm management. It is crucial to understand the decision-making process of farmers and use this information to analyze how farmers derive a personal view of climatic risks (Smit and Skinner, 2002).

The qualitative approach of this research offers a snapshot of how farmers are thinking about climate change. Qualitative research attempts to understand how people interpret and make meaning of their world (Ritchie and Lewis, 2003). It seeks deep insight into the complex human thought invested in acquiring and processing information about the environment within the broader context of society. Qualitative methodology allows the researcher to take the reader on a journey through an issue and reveal a multifaceted, "holistic picture" of the process of inquiry into how the research participants are creating meaning of the issue (Creswell, 1998).

2.2 **Interviews**

This study, while not easily generalized, shows how the participants within a specific time and place perceive climate change. However, careful explanation of the methodology used allows the research to be replicated at a different site or in a different time period. I interviewed farmers over a one-year period, starting in the spring of 2006 and finishing the following summer in 2007. Since beginning this research, climate change information and discussion has proliferated the main stream. In 2007 the Nobel Peace Prize was co-awarded to former Vice President Al Gore for his documentary

on climate change and the Intergovernmental Panel on Climate Change for its ongoing assessment and communication of climate change research. In 2006 the director of PASA spoke about the importance of climate change research at the yearly PASA conference. The increased dialogue on climate change gave the responding farmers more opportunity to develop informed perceptions about climate change and how it may affect their own farming practices. In questions regarding current climate variability, the farmers interviewed towards the beginning were thinking about a recent drought while the next growing season had severe flooding which influenced those interviewed later in the year. Often, though, farmers brought up droughts and floods from previous growing seasons.

I interviewed 13 farmers in total, 7 sustainable, 5 conventional and 1 mixed-operation (with both certified-organic and conventional components to his farm). When I began the interviewing process, I was interviewing all types of farmers and then narrowed it down to produce (vegetable and fruit) farmers because more of them agreed to being interviewed. Qualitative research calls for a flexible research design (Ritchie and Lewis, 2003) that allows for the researcher to make adjustments that yield the highest quality results. In total, I interviewed 10 produce farmers, 2 livestock farmers (one conventional and one sustainable) and 1 crop grower (with a mixed-operation both certified organic and conventional) with a tiny produce operation.

The PASA membership list, with the permission of the organization, was used to define and contact the sustainable farming interviewees. From the PASA definition that was introduced in Chapter 1, sustainability is largely self-defined by the user. As a researcher, I felt that the 'sustainable farmer group' should contain those who have self-identified as sustainable farmers by becoming members in a non-profit organization for supporting sustainable agriculture, thus minimizing researcher classification bias. The conventional farmers were selected from the same geographical region, with attempts made to retrieve interviews from all the counties in the study region. To arrange the interviews I called the farmers and explained my research objectives and the interview process, asking to meet with them at their convenience. Some farmers were too busy or did not want to be interviewed. The farmers that chose to be interviewed gave me at least an hour of their valuable time.

Ten of the interviews involved on-site visits to the farm. Following a tour of the farm which both put the farmer at ease and helped me to better understand their operation, the farmer(s) and I sat down and began our session. I did three interviews over the phone which yielded straight forward answers but without as much nuance. The phone interviews were necessary because it was what the farmer requested and I did my best to draw out the farmer into a narrative. The challenge of qualitative research is to cultivate an interview in order to keep the conversation on track and effective while maintaining a comfortable, safe space for the interviewee to

share. The interviews averaged approximately 1 hour and the audio was recorded with the consent of the respondent.

"The aim of an interview is *not* to be representative but to understand how individual people experience and make sense of their own lives" (Valentine, 1997, p.111). In this way, the differences between some interviews is to be expected as individual participants have different needs, in-person versus on the telephone, and make different choices in what they like to discuss. I used an interview script (see Appendix) to allow for comparison but with mostly open-ended questions to encourage a personal, thoughtful dialogue. The interview questions were more like themes for the conversation (Valentine, 1997). Interviews "take a conversational, fluid form, each interview varying according to the interests, experiences and views of the interviewees" (Valentine, 1997, p.111).

The interviews began with background questions about the farmer and farm characteristics and operation. This preliminary section also aimed at allowing the respondent to achieve comfort with the interview and to encourage their robust participation in the process. The subsequent section contained questions probing how the farmer worked through specific climate variability, either a drought or flood from the previous two seasons and how that experience has affected their future planning. Next, the farmers were asked what sources they relied on for information on weather and climate change and how they interpreted that information and applied such in their management decisions. They were asked to gauge the sensitivity of their

buyers to the effects of weather and climate on their produce. The farmers were also asked how they prepare to face long-term changes in climate. The interviews ended with farmers self-categorizing themselves as sustainable, organic or conventional farmers.

Figure 1 showed the pathway of analysis of the interviews. The arrows emphasize the iterative nature of analysis by constant rechecking of results with the actual transcripts, which ensures that the findings accurately portray the interviews. I began by analyzing each interview separately, making notes in the margins and highlighting important quotes and words. After completing this for each interview, I began to do the process again but looking for themes that came up repeatedly within the groups and for all the farmers. This analysis is very labor-intensive and takes continual checking and reexamining of the transcripts.

Qualitative analysis is a very creative and individual process (Crang, 1997). Another researcher would likely code each interview differently. After the coding process, I began to write a narrative of the results using the themes that came up in the interviews as an outline. These themes and narratives make up the next results chapter.

It is vital in qualitative methodology to allow the reader to know the point from which I approach my research and to, therefore, participate more fully on the journey of my project. Part of doing qualitative research is a "consideration of the influence of the researcher's perspectives" (Ritchie and Lewis, 2003). I have attempted to make my analysis as free from personal

bias as possible. I try to represent each interview and farmer truthfully and respectfully in the results chapter. I also provide the reader with actual interview dialogue throughout the results. I believe, however, that it is impossible to be completely objective and therefore it is important to be transparent about my own background and perceptions.

"It is important to reflect on who you are and how your own identity will shape the interactions that you have with others" (Valentine, 1997, p.113). I have known several of the sustainable growers for years. I have volunteered at several of the farms and been active in the sustainable agriculture movement, including as a PASA member. Also, I have known some of the conventional growers personally and as a general member of the community. I have never discussed climate change with any of the farmers on previous encounters. This position has allowed some degree of trust from my respondents. Those two positions, of both activist and community member, challenged me to remain objective, thoughtful and rigorous.

2.3 **Study Area**

Pennsylvania has primarily a humid continental type of climate with westerly winds carrying interior weather to much of the state. The temperatures range from 0 to 100 degrees Fahrenheit with an average temperature of 47 degrees. Statewide the average precipitation is between 34 and 52 inches. Flooding is common throughout the state and most often

occurs in the spring caused by the combination of heavy rains and snowmelt. Tropical storms, usually as remnants of hurricanes, occasionally deposit heavy rains in the east. The summertime rainfall mostly occurs from intense localized thunderstorms. The weather and climate is greatly affected by regional physiographic features (http://climate.met.psu.edu/www_prod/data/state/).

The climate zone for most of the study area is ridge and valley. The ridges are between 1300 and 1600 feet above sea level with local relief of 600 to 700 feet above sea level. This topography causes greater temperature extremes then the rest of Pennsylvania and slightly shorter growing seasons in the valleys (http://climate.met.psu.edu/www_prod/data/state/).

The ridge and valley topography feature forested, sandstone ridges of sandy loam. Then shale foot slopes meet with limestone-derived valleys that have deep, well-drained soil and are productive agricultural zones. Some of the valleys are shale-derived and less productive. The valleys are used intensively for agriculture (http://extension.psu.edu/agronomy-guide/cm/sec1/sec11a) (see above photograph labeled Figure 2).

Figure 2: Farm fields on a succession of ridge tops. Source: Allyson Jacobs

Lycoming County (see Figure 3 below) is partially in the Allegheny High Plateau which is mostly forested, with a high elevation, short-growing season and erosive slopes (http://extension.psu.edu/agronomy-guide/cm/sec1/sec11a).

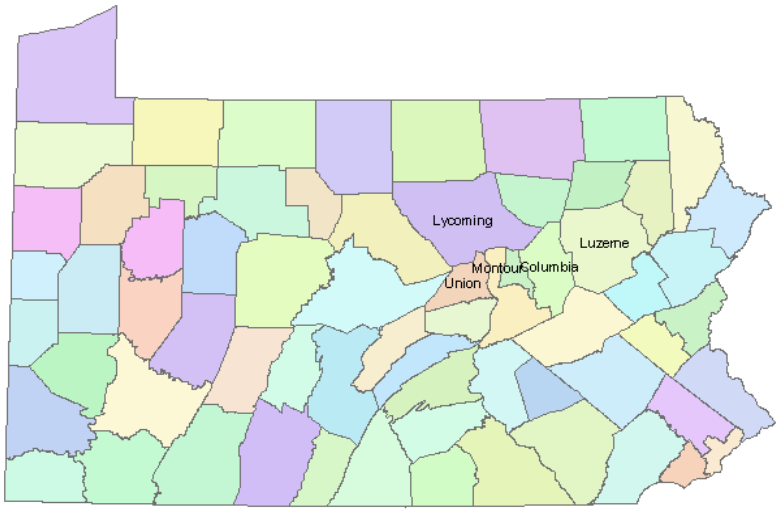

Figure 3: The counties within Pennsylvania where interviews took place.

The Susquehanna River flows through this region of northeast-central Pennsylvania, eventually supplying the Chesapeake Bay with 50% of its freshwater. The Chesapeake Bay has historically suffered from agricultural pollution in the form of nitrogen, phosphorus, and other chemicals in runoff. A partnership of agencies, including the Susquehanna River Basin Commission (http://www.srbc.net/), the Chesapeake Bay Foundation (http://www.cbf.org/Page.aspx?pid=1000), county extension offices and farmers have partnered to improve water quality and ultimately the health of the Chesapeake Bay (Sweeney, 2009). They lead educational programs and monitoring, encouraging best management practices to reduce runoff and erosion and keep animals out of streams. According to the Chesapeake Bay Program, since 1985, the program controlling nitrogen, phosphorus and sediments has reached nearly 50% of its goals (Sweeney, 2009).

The study area for this research, primarily in the ridge and valley region and the watershed of the Susquehanna River includes five counties; Columbia, Luzerne, Lycoming, Montour and Union, (Figure 3). I chose this region because I grew up on a farm in this region and feel a strong personal interest in the health of its agricultural community. My knowledge of the area helped in obtaining interviews with farmers, many of whom I was already acquainted.

Pennsylvania's top 5 agricultural commodities in 2009 were dairy products, mushrooms, cattle and calves, corn and broilers. While the percentage of state farmland has barely fluctuated since 1997, PA added

17,874 certified organic acres from 2006 to 2008 (http://www.ers.usda.gov/Statefacts/PA.htm). Pennsylvania is the third state behind California and Washington in total organic agricultural sales (http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Fact_Sheets/organics.pdf). The study area has both small-scale conventional and sustainable farmers including the vegetable growers that I highlighted. Columbia County, where agriculture yields 40 million dollars in gross receipts a year, has 37 percent of its land in agriculture production. Columbia County agriculture focuses primarily on field crops, vegetables, dairy products, Christmas trees, cut flowers, and horticultural specialties (http://columbia.extension.psu.edu/countyinfo.html).

County/Study Area State	Population	Total Area (m2)	Water Area (m2)	Land Area (m2)	Pop/m2
Columbia	64,151	489.79	4.24	485.55	132.1
Luzerne	319,250	907.13	16.32	890.81	358.4
Lycoming	120,044	1,243.77	8.91	1,234.85	97.2
Montour	18,236	132.3	1.55	130.75	139.5
Union	41,624	317.12	0.39	316.73	131.4
Study Area	563,305	3,090	31	3,059	184
Pennsylvania	12,281,054	46,055.24	1,238.63	44,816.61	274.00

Source: Census of Population

Table 1: Population Statistics for Study Area

County/Study Area State	White%	Black%	Hispanic%	Asian%
Columbia	97.60	0.80	0.90	0.50
Luzerne	96.60	1.70	1.20	0.60
Lycoming	93.90	4.30	0.70	0.40
Montour	96.70	1.00	0.90	1.30
Union	90.10	6.90	3.90	1.10
Pennsylvania	85.40	10.00	3.20	1.80

Source: Census of Population

Table 2: Racial Statistics for Study Area

County/Study Area State	High School	Bachelor's or higher
Columbia	80.60	15.80
Luzerne	81.10	16.40
Lycoming	80.60	15.10
Montour	82.30	22.10
Union	73.10	18.00
Pennsylvania	81.90	22.40

Source: Census of Population

Table 3: Education Statistics for Study Area

County/Study Area State	MedianIncomeHousehold	FamiliesBelowPovertyLevel%
Columbia	34,094.00	7.10
Luzerne	33,771.00	8.10
Lycoming	34,016.00	7.90
Montour	38,075.00	4.50
Union	40,336.00	5.10
Pennsylvania	40,106.00	7.80

Source: Census of Population

Table 4: Income Statistics for Study Area

County/Study Area State	Farms #	AverageSize(Acres)	AverageValue	%From Crops	%From Animals
Columbia	884	140	39,732	55	45
Luzerne	548	134	40,887	81	19
Lycoming	1,323	134	37,187	32.9	67.1
Montour	304	131	90,178	71.2	28.8
Union	521	133	105,597	10.2	89.8

Source: City-County Data Book

Table 5: Farm Statistics 2002

County/StudyArea State	Acres Certified Organic	Organic Operations
Columbia	*	3
Luzerne	92	7
Lycoming	260	9
Montour	403	8
Union	1,576	13
Study Area	2,331	40
Pennyslvania	45,181	775

* Data Unavailable

Source: 2007 USDA Agricultural Census

Table 6: Organic Statistics by County

The socio-economic and agronomic variables summarized in the preceding tables (1-6) show a basic picture of the study area. The study area is less populated than the rest of Pennsylvania except for Luzerne County which has a concentrated metropolitan area (Table 1). The study area, which is predominately white (Table 2) has an average high school graduation rate for Pennsylvania and a below state average rate of graduates from institutes for higher education (Table3). The farmers I interviewed were generally more highly educated than the mean of the region, although the Census of Agriculture does not provide information on farmer education-levels at the

county level. All of the sustainable farmers had at least a bachelor's degree and several of the conventional farmers did as well, including degrees in agricultural related fields.

The median household income is below the state average in all counties except Union (Table 4). Union county also has the largest average monetary value by farm (Table 5) and by far the largest amount of certified organic acres (Table 6). Not all of the interviewed sustainable farmers were certified organic which can be costly and the census tracks only certified farms. The research participants labeled themselves as sustainable farmers.

Growth in organic agriculture in Pennsylvania, as discussed above, is an important part of the state's economy. Most of the statistics on organic agriculture from the agricultural census are not available in any form of completeness before 2007 but for some counties in the study area there were reported increases in both operations and acreage. Union county is the only county in our study area with a complete date range from 2002 to 2007, which had an increase in organic operations from 4 to 13 and acreage increases from 1,073 to 1,576 (http://www.agcensus.usda.gov/Publications/2002/Volume_1,_Chapter_2_County_Level/Pennsylvania/index.asp) (Table 6).

Figure 2, showing the rolling ridge and valley region, with fields and an unseen dairy farm nestled in the valley, is typical of much of the study area. The farms are small, on average about 134 acres (Table 5). Organic

farms are rapidly increasing in number and economic importance. Next, I will portray the narrative from these farmers about climate change.

Chapter 3: Farmer Narratives On Climate Change

This chapter gives the findings of my interviews with sustainable and conventional farmers relating to their perceptions of climate change. I use interview quotes within each section's discussion, denoting them in bold script. After the quote I will indicate (SF) for sustainable farmer, (CF) for conventional farmer, or (C/O F) for the mixed operation for greater clarity. Appendix B offers an in-depth series of interview quotations that are pertinent to and correspond with each section of this chapter. There are often more responses from one group than another because that is what came up in the interviews. Also, at several points I discuss something that only concerns one group, without much input from the other due, again, to the points of discussion determined by the interviewees. For example, the Community Supported Agriculture (CSAs) was a phenomenon of great importance to the sustainable farmers but not one in which the conventional farmers participated.

3.1 CLIMATE CHANGE PERCEPTIONS

3.11 Sustainable Farmers-Climate Change as Real

All the sustainable farmers agreed that climate change is happening, often stressing this as if repudiating the assumption of widespread disbelief that is apparent in political and media discourse. They affirmed that climate change was a real phenomenon that would have felt consequences. **"Climate**

change is going to affect everyone."(SF) The Intergovernmental Panel on Climate Change states that it is important for farm managers to know that climate change is a real and continuing threat in order to help facilitate adaptation adoption strategies ((Parsons et. al., 2003) cited in (Easterling, 2007)). Many sustainable farmers spoke of keeping informed on environmental issues. One farmer even had a climatologist-professor father who lived on the same farm and had discussed climate change issues with his family, informing them that it would most likely be felt through a series of above and below average moisture related events.

Research on perceptions and action has found that, risk perceptions, knowledge and general environmental beliefs increase the desire to actively work on environmental problems (O'Connor et. al., 1999b). Most of these farmers chose to farm sustainably in direct response to environmental issues such as agricultural chemical usage. Not surprisingly, none of the farmers had sought out research on climate change in order to specifically incorporate it into their management plans; instead feeling that most climate change related phenomenon, short of catastrophe, could be absorbed if they kept on target with their in-place management plans, often focusing on soil quality.

3.12 **Conventional Farmers-Unsure about Climate Change**

On the conventional side, farmers felt unsure about climate change, particularly because, as many stated, they have not given it much thought. Several farmers, all with conventional or mixed operations felt that they did not **"read much into it"** and this response was almost always coupled with a belief that IF climate change is definite it will not happen within the respondent's lifetime. If climate change did not come up in our conversation and I asked directly about climate change, most of the conventional farmers changed their receptivity to the interview, relaying with facial gestures or voice intonations that I was being a little silly. I tended to ask direct climate change questions towards the end of the interview in case it inhibited their receptivity to the interview process as a whole.

Both groups felt that they coped with weather on a day-to-day basis and climate variability from year-to-year. However, the conventional farmers felt that climate change was not within their scope of management. Several felt that they doubted whether climate change would have large consequences in their lifetimes although they did believe that the climate is more extreme now, in frequency and intensity of storms and drought. One conventional farmer, despite feeling like he **"did not know"** about climate change, advises that, due to the patterns in weather he has observed over 20 years of farming**, "If you didn't have an irrigation system, you'd better get one."**

Another conventional farmer felt that even the Bible talks about climate changes, giving Noah's flood as an example and said that scientists are overlooking that climate change might be planned by God or simply not explainable. He said of climate change, **"I think it is blown out of proportion. That doesn't mean we shouldn't do everything we can. We are not here to rob the ground…We have to give the ground back better than we got it."** He was concerned for both the environment and the continued viability of farming. In the previous section we reflected on the connection between environmental beliefs and the desire to act environmentally responsible (O'Connor et. al., 1996). The response of this conventional farmer shows that if climate change was framed as a specific environmental concern for his farm and in a way that he felt was reasonable, not **"blown out of proportion"**, then he would be more likely to participate in climate change related initiatives and planning.

3.13 **Climate Change as Positive-Economic Motivation and Ticks as Refutation**

This section explores interesting responses from the farmers, most jokingly and one seriously about the possibility of climate change as they perceived it being positive. A witty sustainable farmer said that another farmer they spoke with could not wait for climate change because they expected a bump

in climate zones. Other farmers (both sustainable and conventional) joked about climate change being good for them through an increased growing season, laughing about growing olives in the upcoming Mediterranean climate. However, seriously, one sustainable farmer expected climate change to be positive for his operation. The farmer with a mixed, conventional and organic, hay and grain operation felt that climate change was not a concern in comparison with the rest of the sustainable and/or organic farmers who felt that climate change was a deep threat. These last two examples, that climate change was positive for the operation and the only organic farmer who was uninterested in climate change, were perplexing.

Within this limited research project, those two responses led me to wonder that if the motivation behind adopting sustainable/organic farming is mostly economic then there is a greater chance in perceiving that climate change will be either positive or not an issue. Again, I refer to the research on perceptions and action that shows that environmental beliefs increase the desire to actively work on environmental problems (O'Connor et. al., 1999b). That gives some support to the inverse supposition that without strong environmental beliefs there is not motivation to learn about and work on climate change mitigation. The sustainable vegetable grower who appears primarily economically motivated felt that climate change would boost his farming operation because the layout of his property protected him from heavy storms and flooding. He felt that "things can only get better for me." There are two consideration of importance here. The first is that even

though he genuinely felt that climate change benefits his operation, he felt that it was a threat in general. The second is that it is a large assumption that his primary motivation is economic. He was very negative about his customers, acting more like he was conning them with higher prices. Again, the interview may have taken place on a bad day!

The farmer with a mixed, conventional and organic, hay and grain operation felt that climate change was not a concern in comparison with the rest of the sustainable and/or organic farmers who felt that climate change was a very important concern. He specifically converted some of his operation into organic hay and grain because of economic incentive. He is the only sustainable/organic farmer to not be interested in climate change at all. Is that a correlation? It certainly points to the need for more research.

While there are of course economic incentives involved for the more environmentally focused sustainable farmers, they spoke of farming as revolutionary and political. A study found that organic farmers are more likely to speak of the objective to maintain 'profitability' while conventional farmers of 'making a living' (McCann 1997) and that profitability, as expressed by sustainable farmers, seems to be of a more holistic view inclusive of healthy soil, healthy lifestyle as well as farm accounts. In part, this finding within the narrow scope of those interviewed in this project may result from a lack of knowledge about climate change or, more broadly, in environmental issues in general. And, while this discussion is interesting, it

is only an indicator for more research on the subject. The research is particularly timely as more organic farms are fulfilling customer demand.

One sustainable grower said that he heard many people talk about climate change as a good thing and he felt that most people forgot that with climate change also comes an increase in disease and pests without the ability to adequately develop strategies to deal with them. This farmer felt strongly that this specific misinterpretation of climate change could have disastrous consequences.

Several farmers on both sides of the spectrum brought up ticks as an example of how weather has changed over the years, not freezing hard and long enough, anymore, during the winter months to kill them off, although often this comment was not coupled with outright belief in climate change from the conventional farmers. Figure 4 shows the incidence of Lyme disease, contracted by ticks, for the Northeast and North-central regions of Pennsylvania where the study area is situated. Lyme disease has been on the rise both regionally and statewide. Lyme disease outbreak is high where there is high tick density, but this has increased in the 20th century with reforestation and managed deer populations (Randolph, 2001). There also has been an increase in tracking and diagnosis of Lyme (Randolph, 2001). The New York Times reported a spreading of ticks into northern territories, particularly in Sweden, due to climate change but does not mention possible land-use changes in those northern regions (Fountain, 2006, http://www.nytimes.com/2006/06/04/weekinreview/04fountain.html?scp

=1&sq=ticks+AND+climate+change&st=nyt). Increases in ticks may be an example of land-use changes and management being mistaken for climate change. However, The New York Times article synthesizes the argument of Thomas Lovejoy, president of the Heinz Center on environmental policy, by stating that "the increase in nuisance species…may help raise awareness of climate change" (Fountain, 2006).

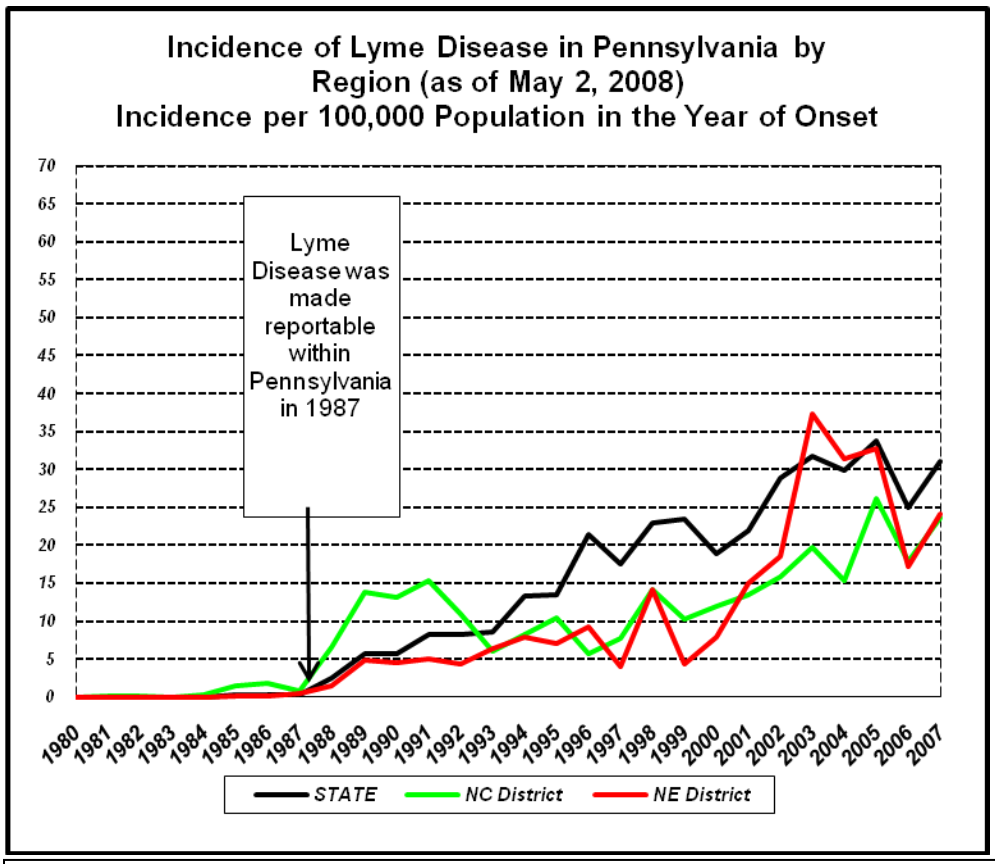

Figure 4: Incidence of Lyme Disease in Study Area Regions

Source: Pennsylvania Department of Health http://www.portal.state.pa.us/portal/server.pt/community/diseases_and_conditions/11595

3.2 SOIL QUALITY AND MANAGEMENT PLANS

This section discusses what I think are the most important findings from this research. The sustainable farmers emphasize soil construction, the building up of organic matter and microbial activity in the soil as their management focus and suggest that this robust soil will protect their farm from most effects of climate change. While there was farmer consensus on the inability to make a climate change management plan many felt that benefits from the on-going management objectives they already had in-place could positively improve their climate change adaptation. There is a discussion on the complex and at times confusing ideas about irrigation adoption and technology use. Also, we will compare sustainable agriculture's management strategies in combination with recommendations for climate change adaptation from the IPCC (Easterling, 2007, 294) in support of the finding that "the mutually supportive relationship between sustainable agriculture and climate change adaptation could be used to justify more government support for sustainable agriculture" (Wall and Smit, 2005).

All the sustainable farmers interviewed repeatedly maintained an overall discourse on soil quality throughout their narratives. Previous research that compared risk management between conventional and organic farmers found that organic farmers cited organic farming practices that manage soil health such as increasing soil organic matter, as a key strategy to buffer from risk such as bad weather and pests (Hanson, 2004). My research finds that sustainable farmers believe that overall soil health, including the

results of the management practice described below as 'moisture management', will greatly aid in their coping with climate change short of catastrophe. Most of the farmers felt that they were still working towards achieving healthy soil, which was the focus of their yearly goals. Many of the management practices that were indicated as improving soil quality were cover cropping, compost application, mulch application, ridge till, no-till, and letting land remain fallow and row cover and hoop houses that directly protect soil. One sustainable vegetable grower summed it up with, **"It all begins with the soil and everything thereafter you are just dealing with symptoms. If you don't have healthy soil it doesn't matter what kind of summer you have. Really healthy soil should be able to do well on a rainy year or a hot year."** The management plans discussed by the sustainable farmers were considered by them to be crucial for the progress of their farms.

Many of the sustainable growers, especially two who are leaders in the sustainable vegetable field, publishing and speaking regularly, cultivate for moisture or practice moisture conservation/management. These practices build the soil through increased organic matter and microbial activity and protect the soil through mulch, compost and cover crops. The ultimate goal is to conserve moisture for times of dry weather, to protect soil from storms and have well-aerated soil for efficient drainage of excess water. Several sustainable farmers mention finding many of these techniques in old books.

Are conventional farmers doing these same practices? Of the conventional growers interviewed, one used row cover and another would like to move towards no-till but most did not discuss these specific practices. The mixed operation grain farmer used no-till on his conventional ground but not on his organic ground. It is possible that they used some combination of these practices. In general the conventional growers were more likely to discuss irrigation as a current or future solution to issues like drought. None of the conventional farmers spoke of soil quality specifically or discussed having a tangible management plan although both repeatedly came up with the sustainable farmers.

The sustainable growers all discussed some combination of soil management practices, relying heavily upon them in their farm management plans. I did not ask questions directly about soil quality and the only direct question about management plans was if the farmer had any that dealt directly with climate. Another study found that both conventional and organic farmers have an understanding of soil erosion and conservation techniques like no-till [3]and conservation tillage (McCann, 1997). However, organic farmers use a greater variety of practices to address soil erosion and

[3] There is a substantial difference between the organic and conventional practice of no-till. Conventional no-till relies heavily upon the use of herbicide. The conventional practice is illuminated in a quote from the landmark book *Silent Spring* by Rachel Carson. "The 'agricultural engineers' speak blithely of 'chemical plowing' in a world that is urged to beat its plowshares into spray guns" (69). The Rodale Institute makes a clear distinction, "Organic farming has relied heavily on tillage for weed control. And conventional no-till techniques depend entirely on herbicides for weed control and effective cover crop kill. Organic no-till is based on sound biological principles and mechanical cover-crop kill, making it possible to reduce and even eliminate tillage" (http://www.rodaleinstitute.org/no-till_revolution).

soil health (McCann, 1997). It appears that the variety of practices to promote overall soil health listed above used by organic farmers have not been largely adopted by conventional growers (McCann, 1997) but some of this may also be a question of scale, although all of the farmers that I interviewed in both groups had small-scale operations, operated by two or three people. The one conventional farmer who wanted to put no-till into practice on his farm felt that using no-till would help him to better protect his soil from severe rain storms and to conserve some moisture.

3.21 Consensus on the Necessity and Strength of Crop Diversity

The sustainable farmers often spoke directly of the importance of having a diversity of crops and varieties. They talked about this as aiding in their protection from stressful weather during the growing season and even a bit with regard to climate change when we were discussing their management plans in dealing with weather and climate. **"Diversity is very important, it insulates you some from weather." (SF)** They talked about trying different varieties to ensure that they would have at least some of a specific crop depending on what variety held up best during the growing season. **"The large variety of crops aid in adaptability to weather. For instance, last year we put in three kinds of snapbeans, 1 an experimental French bean**

which did really well during the drought. The old standby Provider didn't do well. Variety of lettuces, some did better than others." (SF)

The mixed-operation grain and hay farmer maintained that after going through a drought, **"I am more diversified."** This farmer who has a conventional grain operation and an organic hay and wheat component found that if he had not switched partially to organic farming he would probably not be in business. The output of conventional agriculture is primarily sold on the commodities market while the output of organic agriculture, hay, is sold mostly to local dairy farmers. This connection with the local market has increased this farmer's market diversity and allowed for greater security. Also the hay crop has at least four cuttings throughout the summer season, allowing for some yield even if some of the season is unfavorable.

The conventional side did not talk about crop diversity specifically. They did include comments about certain crops doing well at certain parts of the season, **"The temperature fluctuated a lot in late summer so the tomatoes were not growing quite nicely. Hot muggy nights make nice tomatoes, that makes them flavorful. Cantaloupes and watermelon are the same way. Hot muggy nights, though, bring the corn on too quickly though, so this weather is better for corn."** While it was not something they spoke about, the conventional farmers also seemed to have a variety of crops for sale at their stands or growing in their fields although they did not speak about the specifics of planting several varieties of the same crop.

3.22 Irrigation and Technology

Attitudes about irrigation were divided among the groups. Conventional farmers were more likely to use irrigation or to feel that an irrigation system/improved irrigation system would prepare them for climate change, "**If you didn't have an irrigation system, you'd better get one**." One conventional farmer said that he would like to have the money to improve his irrigation infrastructure, creating a more efficient pump and pipe network that would lessen the need to move pipes around during the growing season.

Another conventional farmer mentioned that he simply did not have the water source to be able to fully irrigate. He told me the story that his great-grandfather could have put in a pond with the help of the government--a million and a half gallon pond--but the great-grandfather refused to get a handout. Instead, the great-grandfather used fieldstones to fill in the springs so he could plant the wet parts of his farm. Since that time and decision, houses have been built around the farm and now the farm has drainage problems. The farmer noted that now you could not put in such a pond because of regulations and liability and that the nearby developments draw down the well water source making irrigation nearly impossible. He has a lack of water due to competition for the water supply and a farm that has

poor drainage, so he has problems in both wet and dry years. His hopes remain in a move towards conservation tillage and no-till in order to conserve moisture by preventing soil erosion but for now a no-till planter is too expensive.

While many sustainable farmers used some type of irrigation at some point in cultivation, they often felt that irrigation was a crutch and that, through soil management, either did not need it or hoped to not need it in the future. The overwhelming outlook was that once optimal soil health was achieved on the farm, little or no irrigation would be necessary. **"Ideally on an organic farm you have enough organic matter in the soil to reduce your drought stress. We are getting to the point where it helps us in certain areas on the farm. The plan is to increase that every year as opposed to irrigation." "Really healthy soil should be able to do well on a rainy year or hot year."**

Of the sustainable produce farmers interviewed, 4 out of 6 irrigated. These 4 all had rainwater collection systems, such as roof run-off tanks and in one case a salvaged swimming pool to collect rainwater, in order to supply irrigation and were looking to improve the efficiency of these systems. One of the irrigating sustainable farmers was considering applying for a grant to help with the cost of a solar-powered pump to move water from a pond to the fields while keeping the farm environmentally sustainable; and aspires taking the farm off the grid. Although one sustainable grower relied on already in-place irrigation systems, several felt that an extensive irrigation

system would be too costly a measure in extreme climate change preparation.

One sustainable livestock farmer felt there was a very clear distinction between the adoption of hard and soft technology. He said,

> **"I think that my perception is for organic or sustainable farming it would have to be more of a management 'system' [for coping with weather extremes/climate change conditions] and a flexibility built into your program rather than putting up a certain type of building or buying a certain kind of mister [like in largescale poultry operations], the hard technology. It would have to be soft technology and that means trying different things, whether they are species, or grasses, or patterns, or management systems…And maybe learn from different parts of the world, what they are doing. Because we [sustainable farmers] don't have that much hardware, heavy metal type stuff, technology, that we could use."**

Sustainable farmers often stated that quick-fixes and hard-technology like heavy equipment are the realm of conventional/industrial agriculture and not appropriate for sustainable farmers. This concern does not appear to inhibit the use of sophisticated technology such as solar panels that are in keeping with goals to promote environmental sustainability. In the case of the sustainable produce growers interviewed, one goal of their management systems is to create healthy soil. They feel that such soil would not need to

be irrigated. Sustainable farmers employ a practical strategic management approach to managing the resource base without using conventional inputs.

3.23 Management Strategies and Autonomous Adaptation

This section explores the linkage between sustainable agriculture practices and climate change adaptation strategies. Table 7 compares the interviewed sustainable farmers' practices and responses with a table of specific recommendations from the Intergovernmental Panel on Climate Change on autonomous adaptation strategies for farmers. The comparison is supported by the research finding that there is a "mutually supportive relationship between sustainable agriculture and climate change adaptation" (Wall and Smit, 2005).

Table 7 lists on the left the specific recommendations for autonomous adaptation taken from the IPCC (Easterling, 2007, 294). "If widely adopted, these autonomous adaptations, singly or in combination, have substantial potential to offset negative climate change impacts and take advantage of positive ones" (Easterling, 2007, 294). The right hand column of the table shows specific practices and quotes from the sustainable farmers interviewed that relate to the corresponding recommendation from the IPCC. The reason I am only including sustainable farmers here is that they were doing the agricultural practices that were comparable to the autonomous

adaptation strategies. They were more forthcoming about their management plans and practices.

IPCC Recommendation (Easterling, 2007, 294)	Sustainable Practices of Interviewed Farmers
Altering inputs such as varieties and/or species to those with more appropriate thermal time and vernalisation requirements and/or with increased resistance to heat shock and drought, altering fertilizer rates to maintain grain or fruit quality consistent with the climate and altering amounts and timing of irrigation and other waste management practices	Plant a diverse variety, working with the climate at hand, using organic fertilizer to maintain quality produce by supporting the soil, may use irrigation, incorporates waste products into its soil program
Wider use of technologies to 'harvest' water, conserve soil moisture (e.g., crop residue retention) and to use water more effectively in areas with rainfall decreases	Collects rainwater and water runoff from rooftops, and conserves soil moisture through intensive management such as crop residue retention, mulching, tillage techniques, etc **"Moisture conservation is a driving force of our management."** **"Ideally on an organic farm you have enough organic matter in the soil to reduce your drought stress."**
Water management to prevent waterlogging, erosion and nutrient leaching in areas with rainfall increases	Soil management to create well drained soil and minimize erosion and nutrient leaching **"Really healthy soil should be able to do well on a rainy year or a hot year."**
Altering the timing or location of cropping activities	Flexible with timing of crops and use of hoop houses and row cover
Diversifying income by integrating other farming activities such as livestock raising	Diverse incomes through variety of outlets such as CSAs, restaurants, and farmer markets

Improving the effectiveness of pest, disease and weed management practices through wider use of integrated pest and pathogen management, development and use of varieties and species resistant to pests and diseases, maintaining or improving quarantine capabilities, and sentinel monitoring programs	Use integrated pest management and a variety of pest, disease and weed strategies such as crop rotation without using synthetic herbicides or insecticides. **"A healthy soil is a healthy plant."**
Using seasonal climate forecasting to reduce production risk	Limited use of seasonal climate forecasting

Table 7: Pathways to Autonomous Adaptation-IPCC Recommendations and Sustainable Farmers (Easterling, 2007, 294)

The sustainable growers incorporated most of the IPCC recommendations into their management plans. This finding indicates strength in sustainable agriculture for adapting to climate change. A reminder of the definition of the concept of adaptation used in this context is "both the actions of adjusting practices, processes and capital in response to the actuality or threat of climate change as well as changes in the decision environment" (Easterling, 2007). "In the language of sustainability, the more adaptive capacity a system has, the more resilient it is---the system maintains its integrity despite stresses from internal and external factors (Costanza, et. al., 1992) and hence is more sustainable" (Wall and Smit, 2005). There is a link between the practices within sustainable agriculture and the potential for adapting to climate change. This relationship is rarely discussed in the literature (Wall and Smit, 2005) and is a subject that the IPCC has not explored in their publications (Easterling, 2007).

Researchers Wall and Smit make the argument in a broad context finding that when climate change adaptation strategies are reviewed, there are correlating fundamentals within the sustainable agriculture definition (Wall and Smit, 2005). "The capacity of a farming system to adapt to changing climate and weather conditions is based on its natural resource endowment and associated economic, social, cultural and political conditions" (Wall and Smit, 2005, 115). The official United States government definition of sustainable agriculture is a system with the ability to "satisfy human food and fiber needs; enhance environmental quality and the natural resource base; make the most efficient use of nonrenewable resources and on-farm resources and integrate, where 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" (Gold, 2007, http://www.nal.usda.gov/afsic/pubs/terms/srb9902.shtml#toc3d and http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+7USC3103 (for the government document). So in comparing these definitions, sustainable agriculture is focused on maintaining the strength of each of the parts of the climate change adaptation strategy. That is, sustainable farmers work with their natural resource base and aim to provide food while sustaining the economic validity and heighten the social and cultural context.

The IPCC calls the farmer oriented strategies autonomous adaptation (Easterling, 2007). Table 7 lists the IPCC suggestions for such autonomous adaptation and supports the linkage claims made by Wall and Smit (2005) at a practice-level. Planned adaptation focuses on government policy that encourages and supports successful adaptation (Easterling, 2007). This thesis corroborates "that sustainable agriculture practices are the logical place to begin building that kind of support" (Wall and Smit, 2007, 121).

Most of the sustainable farmers suggested during the interview that small sustainable farms would adapt better with changes in climate than industrial agriculture, large monocultures in particular. Their reasoning included that industrial farmers do not develop the soil health and that the monoculture allows for complete crop failure, while they rely on their own crop diversity and healthy soil to protect them from weather adversity. This sentiment is supported by the connection between the practices of sustainable farmers and climate change adaptability (Wall and Smit, 2005).

A sustainable vegetable grower said that, **"Half of what we do here is political; we are trying to serve as a model. We try to show a viable alternative to industrial agriculture. We are trying to be good stewards."** This statement came during a conversation about where he goes for information about climate change. He commented that he stays informed on a wide range of environmental issues, including climate change because of the desire to be a good steward of the land. His use of the word political is in keeping with the comments of several of the sustainable farmers in that they

feel they are a part of an activist movement in changing the model of agriculture. This model is agriculture is sensitive to environmental issues like climate change.

3.24 Constrained Choice and Autonomous Adaptation

On the conventional side, the postmodern risk society creates a precarious situation due to another powerful entity, the corporate contract. Within industrial agriculture, farmers may enter into contracts at multiple levels, with seed and/or chemical companies, buyers and processers. In certain situations, these companies may be the same. Research has found that often farmers within these agreements are unable to make decisions on their farms that reflect environmental conditions and health (Hendrickson and James, 2005).

During one interview, a vegetable grower said that he was trying a new sweet corn variety with increased insect resistance but could not talk about it because of a contract with the seed company. His perceived inability to discuss the variety shortchanges his ability to learn and exchange information about it with others. I am not sure about the length of the seed contract itself, because later he said that he found that many of the drought resistant varieties were a sacrifice in taste. In environmental terms, with

these contracted varieties, seeds cannot be saved or developed on the farm to create a plant that is best suited for the local environment (Hendrickson and James, 2005). "Decisions about who produces our food, what food is produced, how it is produced, and who gets to eat that food have been steadily moving to the realm of corporation boardrooms. As the structure of the marketplace has changed for farmers, the decisions they can make about what plants and animals to use in their farming operation are being severely constrained" (Hendrickson and James, 2005).

One sustainable farmer discussed how even though he does not have technology like air conditioning for his chickens, during times of stress he would rather have a few birds outside than thousands inside. In reality, the majority of the meat birds in this country are part of 40 integrating firms which controls everything the farmer does (Hendrickson and James, 2005), so the farmer with the thousands of birds inside has little choice about the matter once he signs the contract.

While the literature is describing the constrained choice of farmers to make decisions that support a season's changing weather or environmental concerns (Hendrickson and James, 2005) there needs to be more research into this connection with climate change. In the above Table 7, flexibility is a crucial component in the IPCC's recommendation for successful autonomous adaptation to climate change (Easterling, 2007). I argue that the stringencies of the corporate contracts, with its hand tying of farmers to tweak seeds and to make changes, also inhibits their ability for autonomous adaptation

strategies. It also puts a great amount of dependency and control in these same companies in that they will be able to successfully provide seeds and breeds in each locale that will thrive under a changing and ultimately changed climate.

3.3 Reflexive Modernity-Narration on Politics, Strategies and Trends

This section reflects on several components of farming in the age of climate change. The first subsection discusses a strategy that reduces individual risk. This strategy involves the preseason sale of produce shares. This discussion of relationship building continues as we ponder the farmer's role within the local community and through consumer education. Could climate change awareness, response and concern shape these interactions? The last section discusses how farmer education and/or experience may influence farmer adaptation success.

3.31 Community Supported Agriculture

Another interesting shift in sustainable agriculture from conventional agriculture, is the emphasis on Community Supported (or sometimes Subscription) Agriculture, CSA. Farmers sell shares of their produce before

the season, delivering a prearranged amount weekly. Of the sustainable vegetable growers interviewed, four farmers had CSAs and they all cited pre-season sale as a reduction of risk to weather/climate variability. A farmer with a CSA sells shares in the spring, anticipating that the buyer will receive seasonal produce each week of the growing season but also explains that with natural fluctuations in weather and pests they may receive more or less of certain produce. The CSA experience for the consumer is one that includes a close relationship with their farmer and an understanding of what is affecting their food.

The farmers also felt that CSAs were a buffer from climate change. In this way, risk is distributed from the individual, farmer, to a collective. This is a way to *share* risk and educate consumers. **"The CSA members are very understanding, they also get newsletters so they are very educated about the farm. They are taking risks right along with us so they need to know what those risks are." (SF)** While this is not non-capitalist, it is an alternative to the traditional marketplace. Research has shown that belief in the free-market as a primary importance over environmental issues tends to lead to lack of belief in climate change and its human causes (Heath, 2006). This may change when the costs of environmental degradation are out in the open and paid for by the consumer. The willingness of farmers and consumers to embrace the CSA model is a reaction to the modern capitalist system that has not successfully found a way to include negative environmental risks into its economic calculations, except by government

regulation. The community supported agriculture paradigm moves the risks of climate change from the individual back to the group, in a positive way and provides an avenue for consumer education about environmental risks. The avenues for risk distribution available to conventional growers at this time are crop insurance and government subsidy programs.

3.32 Local Community Interaction

All of the farmers interviewed, both conventional and sustainable, sold to a local market. Buying directly from a producer, locally, allows for direct observation and questioning of how the product was raised. According to Pollan (2006), the dialogue encourages community development through an increase in relationships between farmer and consumer. The consumer can ask questions directly to the farmer. One sustainable farmer said that, **"What we are doing is to have a community."** Many of the sustainable farmers spoke about serving their local communities. However, the next paragraph illustrates the need to widen their community and examine how to allow for all participants.

At one point a conventional farmer wanted to know what I thought about the **"organics".** He told me that at a recent regional extension meeting, he felt belittled and monopolized by the organic farmers. He felt that they were blaming conventional farmers for food scares in the country, such as

the e-coli outbreak found on produce in 2007. He explained that he only sprayed pesticides and herbicides at responsible times of the growing season, not close to harvest and consumer intake. While it may take a confrontation to persuade some farmers about the environmental and health reasoning behind organic farming, in this incident it had clearly created distrust and disillusionment through nondemocratic dialogue, creating a segregated *local* community. This structure may then become a barrier to information dissemination on the management strategies of sustainable farmers that increase autonomous adaptation to climate change.

3.33 Customer Awareness Overall

Another discussion that I had with farmers was about the awareness of their customers about climate/weather hardships and their effect on production. I wanted to better understand the economic stress that weather causes. I also was hoping to understand how the farmers educated their customers about climate and weather hardships.

With regard to sustainable farming, most of the farmers felt positively about the climate/weather awareness of their customers. They have found that many of their customers identify closely with agriculture as advocates or former farmers. Most of the farms with CSAs felt that their customers were quite knowledgeable of the weather and how it affected their farm; one farm

actually found that all their core CSA members had small vegetable gardens of their own. All the CSAs included brochures with each weekly delivery, reviewing conditions the previous week on the farm, including whether or not the weather had ups or downs that affected the crops; usually recipes were included for using the produce. **"They [CSA] members are taking risks right along with us so they need to know what those risks are."** Many sustainable growers had a less lucrative time at farmer markets where, with climate hardships, their produce often looked significantly different, particularly smaller, than conventional irrigated produce. All the sustainable farmers felt strongly that educating consumers was part of their purpose, creating a stronger community.

The conventional farmers did not feel that their customers were as knowledgeable about connections between weather/climate and their product. One farmer found that, if people grew up on farms or were older, they generally had a greater understanding of the connection. Another farmer laughed at the question saying that, **"Apples come from a grocery store, not a tree!"** He went on to say that **"In today's economy, the average person has no farm background, they don't care whether it rained or not, whether it was hot or cold, or what happens. [They want a big apple] regardless of taste or anything else."** During a drought several years ago, this farmer found that when he tried to sell small but tasty apples, consumers would not buy them.

Another conventional farmer found that even though there were seasons that drought resistant varieties could be more successful, the taste was significantly different. He was unwilling to sacrifice that taste because that was why people kept coming back to his roadside stand.

One sustainable farmer found that the majority of his customers did not care about the how/why of farming; they just wanted their food. He also commented that sometimes he would deliver the weekly share to the CSA member to find that last week's bag had never been removed from the cooler. He felt that his out of touch customers bought his produce because it was trendy to buy local/organic foods and was quite irked when they asked for tomatoes in June. His experiences seem different from the other farmers with CSAs. He seemed bitter and angry about his relationship with his customers. Interestingly, he was also the only farmer with a CSA that only delivered produce and did not have an on-farm pickup option or a central pickup location. I conjecture that his interaction with his customers were limited so that the relationship building was limited.

With a conventional apple grower, I had a general discussion on how to prepare for climate change that developed into how to make Americans care about the environment and where their food comes from. He told me about his son's soccer team. I will share this rich narration because it illustrates the way this farmer interacts with his community. Also, even though he does not have an informed opinion on climate change, he feels a responsibility to be steward and educator about the environment.

He said that during peach season he took a bushel to soccer practice. He made the children eat one or run a lap after many of them said that they did not like peaches. After they all tried them and loved them, he realized that 9 out of the 18 had never had a fresh peach. He was shocked because he lived in a rural area. This is particularly interesting because he linked long-term financial and food security to a robust local agriculture system and was very concerned by apathetic and unaware local consumers. Concurrently, he felt that climate change would not occur within his lifetime but that we should do everything we can to leave the environment better for the next generation. These sentiments, when allowed to develop in his own way throughout a lengthy interview process, show that ultimately the small-scale sustainable and conventional farmers were both deeply concerned for their local communities but showed that concern in different ways.

3.34 Scientific Knowledge and Prior Experience

The farmers I interviewed came to their farming craft from varied backgrounds. All the sustainable farmers that I interviewed were college graduates, with degrees varying from Biology, Business, Engineering, and a Masters in Economics, including an alumnus of Harvard. They had diverse job experiences, including an executive at Xerox, though most did not have a farming background. While most of the sustainable farmers have been farming for a short time, one family has farmed since the early 1980s, writing

and speaking about the lessons they have learned. On the other hand, the conventional farmers and the mixed-operation farmer were from farming families, including 4th and 5th generations farming on the same property. The farmer with the mixed operation and one of the conventional farmers had agricultural degrees. The sustainable farmers tend to read widely, exploring environmental and philosophical foundations. It seems like they are constantly tweaking their farm management skills, reading old books and new periodicals for suggestions, trying to build their soil health which, from their perspective is also preparing them for climate change.

On the other hand, the conventional farmers have many years of experience and within the group I interviewed, have often spent their lives on their farms learning from the generations who came before them. They know their farms intuitively and know how they are affected by different types of weather conditions and patterns. The IPCC is trying to allow for local, indigenous voices to influence plans on sustainable development and climate change adaptation (Yohe, 2007). This is true even for this region of Pennsylvania. While the conventional farmers are not truly 'indigenous people', in this case we see that the state of being *indigenous* can be considered a fluctuating position. The dialogue between conventional and sustainable farmers in-place, in their locale, is important for how to develop and adapt within the developed country context, with many diverse voices with intricate relationships to their farms. The dialectic of local knowledge, with its inherent "diversity and dynamics" (Zimmerer, 2007) is important to

respect in shaping climate change research and policy. This dynamic relationship may be contentious at times, like for the conventional farmer who felt belittled by sustainable farmers at a meeting. However, both/all sets of knowledge, whether gleaned from articles and then put into practice or passed down from several generations of farmers caring for a piece of land, can provide hope for the adaptation to climate change of small farmers in Pennsylvania.

Chapter 4: Conclusions

This research project started with the hypothesis that sustainable and conventional farmers have divergent perceptions of, and adaptive management practices for, dealing with the influences of climate variation and change on their own production systems. Throughout my findings, I explored their narratives, seeking commonalities and differences. I found that they have a different approach to management that may prove to important to the climate change adaptation process.

The three most important research findings of this research are as follows:

- Sustainable farmers strongly believed in climate change while conventional farmers tended toward skepticism or disbelief in the effects happening within their lifetimes.

- Sustainable farmers felt that their existing management plans aiming to achieve maximum and varied soil quality could protect them from weather and climate short of catastrophe.

- The sustainable growers incorporated most of the IPCC recommendations for autonomous adaptation into their management plans to some degree.

Other important findings from this research include:

- Most farmers were thinking about climate change although many did not explicitly seek out information on climate change but gleaned information through media coverage and conversation.

- Most farmers did not feel that they could personally do 'preparation' or even know what that would entail except for benefits from the on-going management objectives they already had in-place that they felt could positively improve their climate change adaptation.

- Community Supported Agriculture (CSAs) distributes the risk of weather and climate, which many sustainable growers use as a buffer against risk and as an avenue for consumer education.

- Conventional farmers that have entered into contracts with various companies such as seed or chemical distributors have a constrained situation from which to make choices that may inhibit their abilities to adapt to climate change.

From these pinpointed conclusions and all the presented findings, I find that with regard to my original hypothesis, sustainable and conventional farmers do have different perceptions and management strategies for dealing with climate change.

The literature review helped to shape this work, giving precedents for agricultural climate change research including particular details such as using extreme weather events/seasons as analogs. The review also showed a gap in the literature, showing a need for qualitative localized research. The social-environmental theory of Beck's *Risk Society*, allowed the research to deepen with regard to results that aid in both a greater understanding of the actuality of farmers viewpoints and how those perceptions and management

strategies fit into theoretical findings. This research also points toward a need for effective policy that aids farmers during this process of adaptation.

One previous study calls for the need to study climate change and sustainable agriculture jointly. I hope this thesis is a step forward in that pursuit. Those researchers conclude with "The agriculture sector faces increasing challenges from climate and weather risks and there will be pressure on governments to develop appropriate policy to enhance producer's adaptive capacity. This article demonstrates that sustainable agriculture practices are the logical place to begin building that kind of support" (Wall and Smit, 2005, 121). The finding in this thesis that the management practices of sustainable farmers were in line with the autonomous adaptations strategies of the IPCC (Easterling, 2007) provides support to that claim and gives specific practices of importance.

While the specific strategies are important, I want to give an anecdotal example from my interviews of a successful initiative. The sustainable livestock-operation recently received a grant to install a solar power water pump that allows them to use a spring rather than a domestic water source and water their cattle in fields anywhere on the farm. The use of solar power helps to mitigate climate change. The grants covered 2/3rd the cost and was provided through the Chesapeake Bay Foundation (a non-governmental organization) and Project Grass (a Pennsylvania statewide governmental organization). The grant was awarded to provide support for keeping livestock out of the local creek in order to cleanup that water source that is in

the Chesapeake Bay's watershed and to help support grazing farms. The farmers were aware that their new solar powered water pump made their farm more sustainable and increases their resiliency to climate change.

While this example of an individual initiative is successful, farmers are wary of government regulations on their farms. I believe this is across the board. The most vocal critique was from a sustainable farmer. "There was a leader a couple of years ago who said that we can't expect people to quit driving or to not drive their SUVs or in any way compromise their lifestyle. But if we can convince agriculture to reduce their carbon outputs…you know they are actually thinking of making it a requirement in agriculture so more regulations on the farm in order to do something about it [climate change]. It is just ludicrous." The United States Department of Agriculture's Climate Change Program Office is required by the 2008 Farm Bill to create a system in order to track both greenhouse gas emissions and carbon sequestration on farms (http://www.regulations.gov). So, while farmers may not welcome such regulations and farm-tracking, this thesis points to the need to disseminate sustainable agriculture's management practices that will strengthen autonomous adaptation.

One entity important for successful policy adoption is for farm managers to believe in the need to prepare for climate change (Easterling, 2007). Most farmers felt that they did not directly seek out information on climate change but it came to them through media coverage and conversation. All of the conventional farmers and the farmer with a mixed

operation displayed some degree of skepticism about climate change. The doubt factor here, so central to Al Gore's message in the popular film *An Inconvenient Truth*, is that while scientists are cohesive in the 'truth' of a climate change phenomenon, the general media coverage in the United States cloaks the discussion in doubt with phrases like *supposed* climate change (2006). With most of the farmers finding information on climate change through newspapers and news coverage, they are inundated with such doubt, causing a lack of assuredness about the actuality or temporality of climate change. Of course this is also, perhaps, a symptom of the inability for research to specify exact details of how and when climate change will affect precise regions, *something that most farmers noted would be great to have available*. Importantly, many farmers on both sides asked me what they *should* be doing to prepare for climate change. It appears that these farmers want scientific details and would be receptive to extension or other organizations preparing specific information materials.

Motivating farmers to think about how climate change may affect their practices, is a lofty endpoint of this research. The IPCC reports focus on assessing the "magnitude of the threat and thus motivat[ing] the broader community to take an appropriate level of action" (Adger and Kelly, 1999). A sustainable farming pair told my brother that they found our interview really interesting and thought-provoking, causing them to seek out more information about preparing for climate change. I think engaging in qualitative dialogue with the farmers helped to stimulate some critical

thought about climate change. The dialogue and research process certainly was a learning process for me as both an academic and community member.

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APPENDIX A
Interview Script

Interview Script (Ask for tour of farm after interview)

Background Information:

Please describe your farm…

(Information regarding type of farm, market, employment, size)

How long have you been farming?

What was your background before farming?

(Education level, Employment, Scientific background)

What are your required fossil fuel inputs?

Drought-related Information:

How did the drought of the past summer affect your farm?

(Subsides due to crop damage, etc)

How you prepare for the drought because of advanced forecasting?

(*What types of forecasting was used?)*

What will you do differently in the future in response to drought?

Climate-related Information:

In general, where do you get information about weather and climate?

How have changes in climate affected your farm since you began farming?*(Temperature, precipitation, patterns)*

What specific management practices on your farm are directed at dealing with climate?

To what extent are your customers *(buyers)* aware of weather and climate hardships?

What could help you to better prepare for climate variability?

What are the main risks you are concerned with as a farmer *(rank*)?

Where would you rate yourself on the continuum between viewing climate as something you work with or struggle against?

How do you think climate change will affect your farm?

Do you feel prepared to face long-term changes in climate as caused by global change?

What sources would you/do you go to for climate change information?

Do you identify as a conventional, sustainable or organic farmer?

APPENDIX B

Interview Quotations by Sections in Chapter 3

Interview Quotations by Sections in Chapter 3

I. CLIMATE CHANGE PERCEPTIONS

A. Sustainable Farmers-Climate Change as Real

"Agriculture will change."(SF)

"We are very aware of it and just have to work with it."(SF)

"Climate change is going to affect everyone."(SF)

"I have heard people say, 'gee, if we have global warming that is going to be better for us, we will have a longer growing season'…diseases, insects, invasive species…What else are we going to have to cope with because of climate change?"(SF)

B. Conventional Farmers-Unsure about Climate Change

"I don't think I will see much difference in my lifetime, but who knows? Greenhouse gases and things like that? I don't read much into it." (C/O F)

"I don't know about climate change." (CF)

"Really I haven't given a thought to it. If the patterns continue the way they are it will definitely have an impact. Definitely it would, all farmers are dependent on what the climate is." (CF)

"It will affect the next generation not now or in my lifetime. [Later in interview] I think it is blown out of proportion. That doesn't mean we shouldn't do everything we can. We are not here to rob the ground. We have to give the ground back better than we got it." (CF)

C. Climate Change as Positive-Economic Motivation and Ticks as Refutation

"Maybe we will go to zone 4 [jokingly]? Like the grower we talked to who can't wait for climate change." (SF)

"In this area, this is just prime area especially for global warming. The global warming bubble is passing right over me right now in that I have wetter springs and earlier starts, 10 days earlier in germination than 50 years ago. Season extension at either ends. I have to deal with windier conditions and the rogue heavier snow than normal but global warming is great for me. Not good for the Arctic but great for me right now." (SF)

II. SOIL QUALITY AND MANAGEMENT PLANS

"Moisture conservation is a driving force of our management. I think if we hadn't been doing that, [the drought] last year would have been a serious disaster. We had a pretty decent year. [Later in interview] The moisture saving techniques are something that you do all the time. You can't wait until it is dry to start implementing it. Soil is well drained so too much moisture is not really a problem. [Later] Our decision making is based on moisture conservation." (SF)

"Increasing organic matter is central to organic farming. But we want to have the organic matter be from our farm, that is more sustainable. Organic matter increases soil moisture retention." (SF)

"With the use of cover crops and rotation the soil has good soil structure and earthworm activity." (SF)

"Ideally on an organic farm you have enough organic matter in the soil to reduce your drought stress. We are getting to that point where it helps us in certain areas on the farm." (SF)

"It all begins with the soil and everything thereafter you are just dealing with symptoms. If you don't have healthy soil it doesn't matter what kind of summer you have. Really healthy soil should be able to do well on a rainy year or hot year." (SF)

"The real protection to those vagaries of the weather is actually organic matter in the soil." (SF)

"A healthy soil is a healthy plant." (SF)

"Always trying to build up the organic matter and microorganism to provide immunity for the plants. The soil gets better every year." (SF)

"I am not sure how we are going to deal with climate change. That is the misconception. People who deny global warming give allusions to weather. Weather and climate are two different things. Climate change could have long-term dire consequences [that] I am not sure how we are going to protect against."(SF)

"Learn as the climate changes from plants and what works, adapt." (SF)

"It is such a big phase, we can't really plan for it." (SF)

"Snow in June would be the only thing. We will just have to deal with the changes as they come." (CF)

"There has been nothing about the local, about this area in PA, what it will do."(CF)

A. Consensus on the Necessity and Strength of Crop Diversity

"We are diverse enough in our crops that if one crop doesn't do well, it won't be a total disaster across the whole farm." (SF)

"Variety is really critical." (SF)

"The large variety of crops aid in adaptability to weather. For instance, last year we put in three kinds of snapbeans, 1 an experimental French bean which did really well during the drought. The old standby Provider didn't do well. Variety of lettuces, some did better than others." (SF)

"Diversity is very important, it insulates you some from weather." (SF)

"[On a lesson from the drought year] I am more diversified." (C/OF)

B. Irrigation and Technology

"If you didn't have an irrigation system, you'd better get one." (CF)

"We do not have irrigation. Moisture conservation is a driving force of our management. I think if we hadn't been doing that, [the drought] last year would have been a serious disaster. We had a pretty decent year. [Later in interview] Our decision making is based on moisture conservation.

[Later] If it got more severe we would learn how to do it. It really would come down to…have a backup source. Irrigate. It doesn't seem to be an area with abundant water. I think our techniques wouldn't work to grow produce if the water dropped by half but we could grow grains. If things changed that much, the demand would change. People would need enough grain to get through the day not lettuce mix.

We are rare among produce growers because we don't have irrigation. When we speak at conferences, people can't relate to us because they are always going to be able to turn on their sprinklers. I do think there will be times when some of these methods will come in handy. We spoke in Oklahoma and there water issues are huge.

We plant our rows fairly far apart. Pretty big reservoirs of water for crops to draw on. Most people would have three or four rows in that space. Just another water saving technique. We don't cultivate for weed control, we cultivate for moisture." (SF)

"Ideally on an organic farm you have enough organic matter in the soil to reduce your drought stress. We are getting to the point where it helps us in certain areas on the farm…The plan is to increase that every year as opposed to irrigation." (SF)

"Really healthy soil should be able to do well on a rainy year or hot year." (SF)

"We don't have irrigation, during the drought there was sufficient organic matter in the soil to do well." (SF)

III. Reflexive Modernity-Narration on Politics, Strategies and Trends

"[Farmer 1] It is within the no-till movement. When you till the soil you are releasing carbon into the atmosphere. They are encouraging all of these people to do no-till and you are going to be getting carbon credits for carbon sequestration so if there is less carbon released into the air from agriculture theoretically you will reduce global warming.

[Farmer 2] If your soil is 2% organic matter versus 4%, that may actually be a fairly substantial amount of carbon. For me the thing that they aren't really looking at is what are the carbon sources? When you burn up organic matter from the soil it is carbon decaying from the air as carbon dioxide and it may be organic matter. It is not a good idea to do it but still it is recycling. When you mine a fossil fuel to make that chemical fertilizer or pesticide that is new carbon going into the atmosphere. So even if you are sequestering a little bit through the no-till, you are still adding to the new carbon bank. I don't really know if they are quite seeing the big picture there.

[Later in interview, Farmer 1] There was a leader a couple of years ago who said that we can't expect people to quit driving or to not drive their SUVs or in any way compromise their lifestyles. But if we can convince agriculture to reduce their carbon outputs…you know they are actually thinking of making it a requirement in agriculture so more regulations on the farm in order to do something about it. It is just ludicrous.

[Farmer 2] In this case I think there is industry support from GMO Roundup-Ready [for no-till in particular]. You might as well be using…it works and not plow. It is probably better than using all of those chemicals and plowing. It is probably, if you are going to use the chemicals anyway…" (SF)

"Large agribusiness will suffer [from climate change] the most because not sustainable. Also, genetically modifying drought resistant crops will not work in the long term. The country needs to have thousands of small farmers and pay the true cost of food." (SF)

"[In answer to how they self-identify their type of farming] Authentic, Beyond Organic, stricter than USDA organic standards." (SF)

"Unlike the industrial model…" (SF)

"Half of what we do here is political, we are trying to serve as a model, we try to show a viable alternative to industrial agriculture. We are trying to be good stewards." (SF)

"America wants cheap food. Cheap food is bad medicine." (SF)

"[About not being officially certified as organic] Customers certify my products, anyone who comes to the farm…Industrial agriculture does not attract people, this type of agriculture does." (SF)

"And actually in the genetics, I am sure that there are more heat resistant strains [of animals] but it seems like the genetics are going more in the industrial 'get um fat as they can as quick as they can, don't worry about them being able to walk past 9 weeks [chickens]' type of mentality. But the older fashioned, like your layer birds and your mixed breeds do really well, they don't seem to mind." (SF)

"Plus, being this type of farming where you have your animals outside you are more dependent on your natural environment. If we had a big confinement facility we would just turn up the air conditioning or turn on the mister. They have a lot more to lose when they do have something catastrophic happen than we do but they have more control or at least I think they do, over the environment which they are operating in. But I would almost rather have a smaller number of chickens stressed outside than a lot of chickens stressed inside." (SF)

A. Community Supported Agriculture

"[Farmer 1]People ask us about having a CSA and the one reason I feel ambivalent about it is that if you had 100 people all driving out here, you are going to be using more fossil fuels than me driving the truck to town once a week to the farmer's market.

[Farmer 2] Although we could do a drop off point for a CSA. But there are a lot of factors involved in that, like cooling." (SF)

"A home-delivery produce service, along the lines of the old huckster." (SF)

"CSA adds security because sold up front. Variety is really critical. We have a really loyal CSA/customer base." (SF)

"At least all core CSA members have gardens in addition to CSA shares!" (SF)

"The CSA members are very understanding, they also get newsletters so they are very educated about the farm. They are taking risks right along with us so they need to know what those risks are." (SF)

B. Local Community Interaction

"Organic has become such a joke. People think that organic means high prices and from Mexico. We want to see more local, sustainable farm systems." (SF)

"What we are doing is to have a community." (SF)

"We actually did a little survey about that [reasoning behind the choice to buy local and sustainable foods] through the Ben Franklin Trust, it started here…they went around the State and they said, "Why are you buying here?" "What is important to you?" And they talked about price and health and all of those. And I think the issues came out that these type of customers want to buy local, they want to buy clean, and they are will to pay more for food if they perceive it as being healthy and from a healthy farming system. And we feel that we've got a very enlightened crowd, very loyal, returning people, probably more educated and willing to, yeah the chicken is a dollar more a pound but…what were the issues…health, local, there was a concern about antibiotics, drugs in the food system that kind of stuff." (SF)

C. Customer Awareness Overall

"[Farmer 1] Customers are paying attention to the weather because they are thinking about how it affects the growers. That is great!

[Farmer 2] As you develop relationships with people, it has grown. Some people I don't know very well. There are people actually praying for our farm. Restaurants seem to be very different. We supply Wegmans and I know the guy at the produce department pretty well and the produce manager lives fairly close to here. They are incredibly intuitive about the weather. They understand when we can't supply them with something. We've had a couple of their people come out to the farm and look at the crops." (SF)

"If you just sold the industry standard to the supermarket, that lettuce has to weigh a certain amount. There were times this last year we were undersized for that but our customers were happy to have it." (SF)

"We try to keep them aware. Some don't understand the differences. It varies. Some are very in-tune to farming. People who are attracted to the organic small-farm, garden or farm themselves…We communicate a lot with our customers." (SF)

"The size of peppers was complained about so we educated the customers about that. At the farmer's market we are one of only 3 organic growers so the customers mostly notice the differences in size between their produce and the conventional." (SF)

"I think some are actually pretty close to agriculture, either they have been farmers, or are farming now, or just tapped in a little more...

[After coming to their market and talking to several different farmers during a drought] It is going to make them a little more thoughtful that it is not just wonderful that they could swim in their pool everyday, that there is another side to that.

And I would have to say, if the drought conditions are affecting the local food system, people like our customers would be the first to realize. They are more tapped in and aware. And they are reading stuff about global warming and I think they are more convinced it is happening than the guy, dyed in the wool, Republican, business man…if you just lost a bunch of chickens you may be thinking about what is going to happen in ten years." (SF)

"[Farmer with a CSA] I think they have a certain level of indifference to the whole thing. They are so used to seeing produce in a store that they just assume that it is the same thing that I am doing. And that comes out as 'why can't I have strawberries in December?' The level of indifference, 'don't give me green peppers' and I am like 'well, green peppers are coming in.' 'I don't like green peppers.' 'Well, learn to like green peppers cause that is was you are buying into here.' And they want to be able to say, 'that's too much, I want more of this.' It doesn't work that way. I think they just, you drop it off on their back porch. Sometimes they just leave them in there and you come back next week, and 'oh, I just forgot to take it off.'" (SF)

"It doesn't seem to affect them too much. I mean, they are aware but that doesn't mean the prices are going to be higher, it just means they are going to ship more in from the west." (C/O F)

"Older people, especially ones that grew up on farms, understand more about the connection between weather and produce. That doesn't always hold up. They would understand more than people who just live in town." (CF)

"In today's economy, the average person has no farm background, they don't care whether it rained or not, whether it was hot or cold, or what happens [they want a big apple] regardless of taste or anything else." (CF)

"Apples come from the grocery store not a tree! They don't care if the food is shipped from other countries." (CF)

"Customers see that we have all the produce because of heavy irrigation, such as spinach in the drought." (CF)