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**CLIMATE AND CULTURE: VALUES, RISK PERCEPTION, AND  
CLIMATE CHANGE ADAPTATION IN DELTA COUNTY,  
COLORADO**

**BY**

**TARA KANE PRENDERGAST**

**B.A. HISTORY**

**THESIS**

Submitted in Partial Fulfillment of the  
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# **CLIMATE AND CULTURE: VALUES, RISK PERCEPTION, AND CLIMATE CHANGE ADAPTATION IN DELTA COUNTY, COLORADO**

by

**Tara Kane Prendergast**

**B.A., History, Brown University, 2013**

## **ABSTRACT**

This thesis contributes to literature on climate risk perception and adaptive capacity. It is an investigation into the relationship between values, climate risk perception, and agricultural practices at the community scale. Findings indicate that cultural values have a strong influence on both climate risk perception and the specific practices agriculturalists employ to contend with the environmental conditions they find themselves operating within. They also suggest that environmental conditions – specifically the prevalence of microclimates, topographical complexity, and significant preexisting variability – play an important role in influencing agriculturalists’ perception and climate management.

A qualitative project, this paper is based on twelve semi-structured interviews conducted with ranchers and farmers in Delta County, Colorado. Interview participants were recruited using a snowball-sampling method. Analysis relied on an extensive literature review as well as the utilization of open-coding methods to process interview data.

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*“Overcoming barriers to adaptation will require leveraging off the substantial collective knowledge of agricultural systems, yet focusing on values of importance to stakeholders.” (Howden et al, 2007, 19696)*

## **Chapter One: Introduction and Context**

This thesis is an investigation into the relationship between values, climate risk perception, and agricultural practices at the community scale. It can be read as a story of how one agricultural community – in a small county in Western Colorado – contends with a challenging and highly variable climate, and how the practices its members rely on relate to values and climate risk perceptions. It is also an investigation into the ways in which core values impact perceptions of climate and strategies for contending with environmental conditions including variability and climate change. As historical strategies, what people currently do will be the foundations upon which future adaptations will need to be built. Their values and perceptions of risk will either encourage or provide a disincentive for taking adaptive action.

This thesis contributes to literature on climate risk perception and adaptive capacity. Particular attention is paid to the role of values in shaping existing strategies and risk perception. While the relationship between values and risk perception is well established in the literature, much less has been written about the way in which values relate to localized strategies for maintaining viable operations. Findings indicate that values influence strategies in the same way they do perceptions, and that all three categories are related in the core story of the community studied.

Values – associated with individuals and communities – and cultural worldviews are critical to both perceptions of and adaptations to climatic risks. As it relates to human-environment relationships, culture defines what “attitudes and behaviors are appropriate, [and] develops the logic and grammar through which communities interpret and adapt to their environment” (Pendergraft 644). Values can be understood as “organized sets of preferential standards that are used in making selections of objects and actions” (Williams 20). They are the basis of attitudes, beliefs, and behaviors (Schultz and Zelezny). Karen O’Brien and Johanna Wolf argue that the risks of variability and climate change are understood according to value systems. To be successful, solutions and adaptations to climactic challenges must thus be tailored to value systems and worldviews. Values and worldviews are mutually constitutive. Since the cultural theory typology of worldviews is commonly used in analyzing human-environment relationships, I use it to define worldviews in this thesis.

Cultural theory defines four primary types of worldview orientations that influence peoples’ interpretations of the world and, specifically, support or dislike of policies: hierarchical, fatalistic, individualistic, and egalitarian (O’Riordan and Jordan). In terms of relationships to the environment, hierarchists tend believe that nature is tolerant and that environmental policy interventions can achieve sustainability. Fatalists maintain that nature is capricious and that environmental outcomes are “a function of chance” (O’Riordan and Jordan 87). Individualists believe that nature is resilient and outcomes are a “personal responsibility” (O’Riordan and Jordan 87). Finally, egalitarians tend to think of nature as vulnerable and positive environmental outcomes as a function of altruism and common effort. Individuals and communities generally exhibit some mix of these views.

Focusing on values in assessments of community vulnerability and capacity is critical because in doing so “the types of adaptation perceived as effective and legitimate by individuals, groups, institutions, or governments become explicit” (O’Brien and Wolf 237). This argument is well established in the literature (Adger et al.). It builds on theories about the ways in which perceptions of risk (including of those posed by climate factors) are culturally informed and collectively constructed (Douglas and Wildavsky). Empirical research indicates that values, perceptions of both climactic risk and change, and adaptations are highly correlated (Niles and Mueller; Leiserowitz; Saleh et al; Takahashi et al; Weber; Whitmarsh). Some research also suggests that values and belief exert even more influence on risk perception than scientifically assessed physical vulnerability (Saleh et al).

Interrogating the relationship between values, risk perceptions, and existing agricultural practices is valuable in establishing a baseline of knowledge. It also provides an indication of the kinds of vulnerabilities and resilience that may impact future adaptations in specific communities. This matters as we look toward a future in which climate change is likely to produce environmental change at an increasingly rapid rate, stressing the capacity of agriculturalists to adapt (Rosenzweig and Tubiello). Anticipation of this has generated significant interest in defining vulnerability and suggesting ways to strengthen adaptive capacity. Prolific climate change scholars Barry Smit and Johanna Wandel define vulnerability as a function of the “exposure and sensitivity of a system to hazardous conditions and the ability or capacity or resilience of the system to cope, adapt or recover from the effects of those conditions” (2006, 286). Arun Agrawal adds that even if the causes of change are environmental, vulnerability is primarily determined by social and institutional arrangements (2010). The vulnerability of systems or communities is context specific and



shaped by micro as well as macro level processes and conditions. The ability of a system or community to mediate vulnerability is in part dependent on adaptive capacity, which is also context specific (Smit and Wandel).

The viability of any agricultural operation depends in part on farmers' knowledge of the climate within which they operate. This knowledge is passed down through stories, developed through first-hand experience, and learned through studying historical records. Global climate change complicates this equation by potentially rendering the past a weak predictor of future conditions (Weber). Global climate change (hereafter referred to as "climate change") is both a process of progressive long-term change and short-term extreme climactic disruption that will increasingly impact agricultural production and distribution through amplifying climate variability, shifting temperature and precipitation patterns, and increasing the frequency and magnitude of extreme events (Vermeulen et al). Variability refers to "variations in the mean state and other statistics of the climate on all temporal and spatial scales beyond that of individual weather events" (IPCC). There are both natural and anthropogenic causes of climate variability.

With or without climate change, climatic variation has long been a catalyst for agricultural adaptations (Smit et al, 1996; Smit et al, 2000). A number of studies examine agricultural adaptations in relation to variability and climate change without emphasizing the distinction between the two (Thomas et al; Reidsma et al; Bryant et al; Crane et al). The basic premise in this work is that agriculturalists have always to some degree had to contend with inter-annual as well as multi-decadal variability in climate factors; climate change is generally projected to exacerbate existing variability bringing about more change at a faster rate (Thomas et al; Rosenzweig and Tubiello). Variability matters more to agricultural

operations than long-term changes in the average. Changes in agricultural systems tend to be made in response to variation from “normal” ranges of climate conditions, not in response to long-term changes in average conditions (Smit et al, 1996; Crane et al; Katz et al; Yohe and Tol). Moreover, because variability is an integral part of climate change, “adaptation to climate change necessarily includes adaptation to variability” (Smit et al, 2000, 227). Increases in the range of variability may be the most significant directly experienced climate change related challenge for farmers across all types and sizes of operations (Crane et al). While the rate and nature of change may require different kinds of adaptations, the literature seems to find little importance in engaging the difference between natural variability and global climate change. Rather, emphasis is placed on the extent to which knowledge about impacts and adaptations to natural variability can be applied to assessments of future climate change (Smit et al, 1996). Studies of farmers’ relationship to variability thus serve as a baseline for investigations about what might happen under scenarios of climate change, and what agriculturalists in different regions may need to do to adapt.

There is a significant debate about how to define and measure adaptive capacity. According to the IPCC, adaptation refers to an “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC). Adaptations can be either implemented in response to a shock or proactive and aimed at building resilience in anticipation of some change (IPCC; Adger et al, 2009). Adaptive capacity has to do with a system’s ability to adjust so as to minimize harm, take advantage of potential opportunities, or “cope with consequences” (IPCC). Conventional analyses of the limits on communities’ adaptive capacity emphasize ecological, physical, economic, and technical constraints. Neil Adger and his colleagues

challenge this framework arguing that the more significant constraints are actually social and cultural. In their theory, adaptive capacity depends on values, decision-making processes, and risk perception more than precise knowledge about future climate impacts. They suggest that an adaptable society is “characterized by awareness of diverse values, appreciation and understanding of specific and variable vulnerabilities to impacts, and acceptance of some loss through change” (Adger et al. 2009, 350). The implicit argument proposed by this framework is that adaptation is dynamic and socially embedded (Crane et al).

At the community scale, adaptive capacity can be limited or constrained in multiple ways. Some argue that values and culture can themselves operate as barriers (O’Brien and Wolf; Adger et al, 2009). A high level of value diversity may lead to a kind of paralysis that prevents proactive planning or adaptive action. Communities may also be shaped by a high degree of shared values but operate within “cultures of risk denial” that underplay risks and do not acknowledge the need to build adaptive capacity in the first place (Adger et al. 2009, 339). In relation to environmental risks, individualistic cultures are most likely to fall into this category (Pendergraft). There are also structural constraints on community and individual capacity. These have to do with economic, political, and social arrangements (Smit and Wandel) as well as technological limits (Smit and Skinner) and access to resources, information, and infrastructure (Takahashi et al). “Upstream processes” such as water rights and state or federal agricultural and environmental policy also may constrain the range of adaptive action options specific communities have (Evans).

This study is relevant because, although impacts will vary from locale to locale, climate projections suggest that climate change will increasingly stress agricultural operations across the state of Colorado. Statewide assessments suggest that climate change may both positively

and negatively impact agriculture in Colorado. Potential benefits include a longer growing season and frost reduction from increasing temperatures. These are likely to be more than offset by a number of increased stresses including changes in soil, heat stress, changes in snowmelt and runoff, pests, losses in soil moisture, and reallocations of water from agriculture to support growing urban populations. For livestock, which account for the largest percentage of the state's agricultural sector, additional stresses include increased vulnerability to disease, reduced fertility and pasture productivity, reduced weight gain from heat stress, and reduced feed supplies (Childress et al). Finally, there will be increased stress on agriculture across the state resulting from the challenges rising temperatures pose for the ability of ecosystems to recover from multi-year drought conditions (Gutzler and Robbins).

### **1.1 Delta County, Colorado**

Delta County is located on the western slope of the Rocky Mountains in central-western Colorado; it is approximately 100 miles west of the Continental Divide and 60 miles east of the Utah border. The county has a total area of 1,149 square miles and elevation ranges from approximately 5,000 to 11,500 feet. The county's climate is classified as semiarid and, as of 2008, the countywide average growing or frost-free season was 140 days (Amec). The eastern half of the county is mountainous, spanning parts of the West Elk and Raggeds mountain ranges. Its southwestern area is a mix of mesas, river valleys, and canyon lands. The Black Canyon runs roughly east to west through its southern end. Delta County spans five watersheds and is dissected by the Gunnison and Uncompahgre Rivers, which create fertile river valleys for farming.

The county is primarily rural and agriculture is significant to its economy. In 2013 agriculture accounted for approximately 12% of all jobs, which is significantly higher than the state average of 2% (State Demography Office). As of 2015, the county had a population of just over 30,000 people, an aging population, and a negative growth rate; the median age was forty-seven. Eighty-nine percent of the population over eighteen had a high school degree or higher and the median household income was \$42,400 (ACS 2015). The latest available county-level agricultural data is from 2012. At this time, the county was estimated to have 1,250 farms. Most agricultural operations were small, averaging 200 acres and product sales of \$45,000 per year. In terms of land use, half of the agricultural land was used for pasture and a quarter for cropland. By total value of sales, cattle, grains and beans, and fruit were the top three most valuable products across the county (Census of Agriculture).

Scientifically ascertaining how global climate change has or might impact Delta County is challenging. To-date, there are no publicly available projections for Delta County or even the western slope region. Like many rural places across the country, there are no well-established local weather stations. This limits understanding of the area's present climate, as well as how it has changed over time. It also adds to the inherent challenges of climate modeling, making it even more difficult to predict how the climate within Delta County is likely to change. Colorado is arguably the smallest relevant scale for which an analysis of historical and predicted long-term climate trends can be made. Records show that the state has warmed significantly in the last thirty years; annual average temperatures have increased by two degrees Fahrenheit since 1980. Temperatures have increased in all seasons and a trend toward decreasing soil moisture across the state has also been detected in the last thirty years (Lukas et al). Unlike temperature, no long-term precipitation trends have been

observed. However, several studies suggest that distinct patterns have emerged since 2000; snowpack and precipitation have generally been below average and spring snowmelt and peak runoff time have shifted 1-4 weeks earlier (Lukas et al; Gordon and Ojima).

The challenges of scale and modeling are such that predictions for Delta County are not reliable. However, predictions of state averages provide at least some indicator of what to expect. Temperatures in Colorado have been and are expected to continue increasing as a result of global climate change. Statewide averages are expected to increase anywhere from 2.5 to 6.5 degrees Fahrenheit by 2050. Increasing temperatures will lengthen the growing season. A temperature increase of 4 degrees Fahrenheit would lengthen the frost-free season by 20-40 days. Increases are projected to be most significant in high elevation zones where temperatures are colder (Lukas et al). Droughts, heat waves, and wildfires are expected to become more frequent and intense; the range of drought conditions observed in the 20<sup>th</sup> century will be surpassed by 2050 (Lukas et al; Gutzler and Robbins).

## Chapter Two: Methods

Data for this project were collected through semi-structured interviews. The interview protocol was designed according to the mental models approach (Morgan et al, 2002). The mental models approach draws on psychology, communication theory, risk analysis, and decision sciences. It involves conducting open-ended interviews to elicit peoples' beliefs about an issue in a way that allows them to express their beliefs in their own terms while ensuring clarity for the interviewer by using follow-up probes. Necefer et al. (2015) utilized this approach to assess Navajo values and beliefs regarding energy development as a means of understanding how values, specifically cultural and spiritual values on the environment, informed preferences about environmental management.

This method was chosen for several reasons. It is a proven and effective approach for understanding how people perceive risk, and how those perceptions may be connected to values and worldviews. For this type of investigation, interviews are preferred over surveys because surveys are based on assumptions that may miss important context and or relationships. Moreover, as Terre Satterfield et al. point out, the subject matter is complicated and includes “both tangible assets and intangible qualities that are lived or experienced rather than easily articulated in response to the direct question-answer formats that characterize preference surveys and similar instruments of research” (2013, p. 107).

### 2.1 Interview Protocol

Interviews began with a brief introduction, review of informed consent forms, and overview of the interview questions. The protocol was organized into five sequential parts:

(1) basic information, (2) agricultural calendar, (3) variability, (4) role of local institutions and organizations, and (5) climate change. Follow-up and clarifying questions were asked when necessary. Questions were carefully sequenced placing those about climate change at the end in an effort to talk about climate change as an environmental and planning rather than political issue.

(1) *Basic Information.* The first set of questions asked participants to describe their ranch or farm and background in agriculture. They were asked how long they had lived in Delta County, Colorado, whether their agricultural operation was their primary source of livelihood, and what they valued most about living where they do.

(2) *Agricultural Calendar.* This section included questions about participants' timing of primary agricultural activities and the extent to which climate variability influences that timing. Variability has been shown to impact the timing of planting and other production activities; adjusting them is often a key adaptation strategy (Lansigan et al; Howden et al). Since a number of different kinds of agriculturalists (cattle ranchers, vegetable growers, orchardists, viticulturists) were interviewed, the language of these questions differed slightly with each interview. All participants were asked about what kind of water rights they have as well as when their agricultural water is turned on and off. Participants were asked about their planning time horizon, if their agricultural calendar changed over time or from year to year, what caused any changes in timing that had occurred, and whether accounts they heard from long-time agriculturalists in the area reflected any differences in terms of how things "used to be" in previous generations.



(3) *Variability*. Participants were then asked to describe the climate of Delta County as well as their particular farm or ranch. They were then asked about the extent to which weather and climate variability specifically impact their decisions and practices. The researcher provided definitions of climate and variability as given by the Intergovernmental Panel on Climate Change in their 2007 glossary. Participants were asked what they do to contend with variability and climate factors, and then asked what they think it takes to be a successful agriculturalist in the particular environmental conditions of Delta County. Prompts were used to elicit responses about behavioral and management strategies as well as production practices.

(4) *Role of local institutions and organizations*. Questions about variability were followed up with a question about the biggest challenges participants face in their agricultural practice and where, if anywhere, they turn to for assistance in dealing with those challenges. They were asked to talk about interactions with any organizations; federal, state, county, or municipal institutions; and then asked whether they think they are impacted by any of these levels of government. Examples of institutions and organizations given included grower or cattlemen's associations, city council, the county commissioners' office, state agricultural programs, and the United States Department of Agriculture. Participants were also asked whether they discuss ranching or farming with other agriculturalists and whether they are or have been part of any kind of agricultural group or association. Finally, participants were asked about what they think the ideal for local (county) government is in supporting

agriculture. These questions derived from literature engaging questions about the role local institutions have in facilitating agricultural adaptation (Agrawal).

(5) *Climate Change*. In the final set of questions, climate change was introduced as a specific planning consideration and weather-related issue. Participants were asked what climate change means to them. If they expressed a belief in climate change, follow up questions were asked about how, if at all, they think it might impact the climate and their agricultural operation. They were then asked if they consider climate change in their planning and what would be necessary for them and others to adapt to changes associated with climate change. Follow-up questions were not asked of those who expressed distinct disbelief in global climate change.

## **2.2 Participants and Recruitment**

Twelve participants representing the geographical and agricultural diversity of Delta County were recruited using snowball-sampling methods. The researcher contacted five initial participants whose names and farms or ranches were known to her or her family. These initial participants were chosen as they reflected an equal representation of annual, perennial, and livestock operations as well as geographic diversity. Each participant was asked to recommend 2-3 other qualifying people who might be interested in being interviewed. Inclusion criteria were that individuals be over eighteen, speak English, and either own, co-own, or manage a farm or ranch in Delta County, Colorado. Interviews were

conducted between June 2016 and January 2017. Three interviews were conducted in-person and nine were conducted over the phone.

Participants represented the range of agricultural operations represented in Delta County. Three broad categories were selected to represent types of operations: ranchers, perennial agriculturalists or growers (fruit growers), and annual agriculturalists (vegetable and flower farmers). Five of the interviewees were ranchers, four perennial growers, and three annual agriculturalists. Within these groups there were cattle ranchers – running either conventional or small-scale grass-fed operations, orchardists, organic vegetable and flower farmers, a commodity farmer, and a viticulturist. The participants ranged in age between 40 and 75 years of age. Four of the twelve participants are female. Participants reported living in Delta County for between ten and fifty years; seven had lived and participated in agriculture in Delta County for more than twenty years and four were the third or fourth generation to be farming or ranching on their particular plot of land. Eleven of the participants ranch or farm within the eastern half of the county surrounding the towns of Crawford, Hotchkiss, or Paonia. These locations are not exclusive as a number of participants either ran their cattle on public lands or purchased crops (apples, peaches, or grapes) from other counties. The agricultural land upon which participants operate ranges from 5,500 feet elevation to 7,000 feet elevation; the size of farms and ranches range from nine to 5,000 acres. Although political affiliation was not asked in the interview, responses indicate that participants represent a mix of conservative and liberal leaning individuals, which is reflective of the county's political profile. Given the strong association between political affiliation and beliefs regarding climate change (McCright and Dunlap; Weber; Whitemarsh) political positioning was suggested primarily through responses to the questions about climate change.

### **2.3 Coding and Analysis**

Interviews were coded using Atlas.ti and an open-coding method. A first round of coding was done to generate memos identifying categories and themes according to Morse and Richard's analytical approach (2002). The code list for a second round of coding was derived from these memos as well as a preliminary literature review. A typology developed by Shalom Schwartz (1994) and utilized in an analysis of the relationship between values and environmental attitudes (Schultz and Zelezny) informed values codes. Codes for adaptation strategies were informed by a typology defining categories of adaptive action developed by Barry Smit and Mark Skinner (2002). These typologies provided a framework and guidance but were not strictly adhered to in final coding. Only one person (the researcher) coded interviews; if this work is published, two people will redo coding to verify results.

### **2.4 A Note on Researcher Subject Position, and Limitations**

The researcher grew up on a small ranch in Delta County, and has family who continue to ranch there. As such, this work thus borders on being auto ethnography. The researcher's experience and knowledge of the agricultural community in the county contribute to the analysis, serving as both a strength and limitation of the research. Michael Buroway's approach of reflexive ethnography, which emphasizes recognizing that researchers are a part of the world they study and that rigor thus comes in part from interrogating one's own position (2003), lend credibility to the researcher's subject position. To interviewees the researcher presents as much as a kid from the County as a researcher; in a community that is generally distrustful of outsiders and skeptical of intellectuals, this may have contributed to interviewees' openness and candor. Analysis is also strengthened by

first-hand knowledge of the contestations and value-systems that shape the culture of Delta County. The primary limitation is that the researcher does not have the analytical lens of an outsider.

There are other limitations of this project. Perceptions of climate and the effects of climate change are colored by recent weather conditions and events (Hamilton and Keim). Interviews were conducted over the course of eight months. Those conducted in the beginning of this time were influenced by the conditions of the 2015-2016 winter and spring, which were wetter than average. Those conducted toward the end were more influenced by the drier conditions of the 2016-2017 summer and winter. Interviews conducted during the summer and early autumn were more rushed than those conducted during the winter months as growers were busy and expressed having little time leading up to and during harvest. Finally, the interview protocol was broad and would elicit more fine-grained responses if refined. Little or no research of this kind has been conducted in Delta County; further work will be strengthened by the availability of this project to help in establishing a baseline.

## Chapter Three: Findings

### 3.1 Values

Self-direction, universalism, and knowledge exchange are core values among agriculturalists in this community. Self-direction is a category from Schwartz's typology (1994), which is a tool for identifying and categorizing human values. Schwartz argues that the categories reflect the potentially universal aspects of human values thus providing a framework for cross-cultural analysis. The typology organizes 52 descriptors of qualities and aspirations into four overarching categories: Self-transcendence, self-enhancement, openness, and tradition. Each of these is further broken down into two or three sub-categories, which then are associated with a number of different descriptors. Self-direction is a sub-category of openness and universalism of self-transcendence. Self-direction is composed of the following descriptors: creativity, curiosity, freedom, choosing own goals, and independence. Of these, independence and freedom were apparent in interviews. One interviewee expressed valuing self-direction and independence, or the ability to do things according to one's own ideas and time, when talking about the choice to be a farmer:

*"If you were going to compute your hourly wage it would probably be below minimum wage. So the lifestyle aspect of it of course is the tradeoff: your time is your own. That's a big one for people like me. The farm may tell you when you have to do something but you don't have a boss. You do what you want when you want within the parameters of reality" (F12).*

Five different people expressed similar sentiments. Several also made comments about valuing freedom, conceived of as freedom from rules and regulations. For example, when reflecting on the appropriate role of government one interviewee said,

*“They need to just step out and not interfere as long as there are not any issues. We should as a society – one that has a history of ancient transactions – we should be able to deal with our commerce and our lives without their interference” (F2).*

Universalism is associated with, among other things, aspirations of protecting the environment and an appreciation for natural beauty (Schwartz). Both of these were clearly important for half of the people interviewed. One rancher articulated this value in talking about the importance and meaning of land. He said,

*“The land is the foundation of human society and quality of life too. It's one of the most long-term things in sustainability and the viability of future generations” (R6).*

He saw himself as a steward of the piece of land he ranches and expressed a desire to protect its agricultural integrity through careful management. Several others spoke about the importance of protecting the environment through land management practices (such as rotational grazing) and regulations. For example, one farmer said that he believes the county government should do more to regulate oil and gas development. Appreciating natural beauty relates to this concern for environmental protection. One interviewee spoke to its importance for him in saying that he values living in Delta County precisely because of how beautiful and rich in terms of natural splendor it is. He said that if not for the *“space, the quietness, the stars... I wouldn't put up with the high PH and salt and clay”* (F1).

Knowledge exchange is my own term and was derived from of sub-codes. It refers to peer exchange or sharing of information and stories about agriculture. For members of the community studied knowledge exchange describes both a practice and a value. An interviewee reflected on its value in commenting on how talking between agriculturalists happens all the time because,

*“The more we talk and the more we hear peoples’ day-to-day stories and life stories the more we learn. You never know when you are going to learn something from someone. So yes, we talk all the time” (F2).*

The extent to which sharing information and strategies with peers is a value as well as practice was illustrated in the comments of a rancher who spoke about wishing that ranchers talked to each other more. Where the practice was not yet present, the value was.

Each of these three values – self-direction, universalism, and knowledge exchange – were reflected in at least half of the interviews, and mentioned more than once by at least one interviewee. This spread and depth suggest that these particular values are more than individually held. Rather, they are collective and reflect on the culture of the community. Self-direction was the most commonly shared and significant value. This is evident through both the ways in which people spoke about what they care about or why they are agriculturalists, as well as the number of times such a value was mentioned. See Table 1 in the appendix for value counts by category of interviewee, number of interviews, and total mentions. Individual interviewees indicated valuing a number of other things including: adaptability, respect for tradition, protecting the prospects of their children, efficiency, sacrifice, and sustainability. Adaptability and respect for tradition were mentioned by half or almost half of the interviewees, but only once per interview. These values are important to the community, but not as present as the core values identified.

Interviewees expressed a range of values in relation to government. In terms of saturation, there was an almost even split between those who expressed anti-government sentiments and those who saw some kind of role for government in supporting and/or regulating agricultural activities. One farmer articulated one extreme of the range of opinions in saying,



*“The biggest obstacle I have is our Government and their regulation. The new modernized pure food act is a major obstacle. Water regulations - they are continually wanting more water for the larger population areas, taking it away from agriculture” (F3).*

Expressing the opposite orientation another said, *“Planning and regulation of development is a very primary role a county [government] can play”* (R6). Several comments reflected somewhat qualified beliefs or values in relation to government. For example, one interviewee said,

*“They [government] need to be smart and they need to make sure that proper and smart laws are in place, then they need to just step out and not interfere as long as there are not any issues. We should as a society - one that has a history of ancient transactions - we should be able to deal with our commerce and our lives without their interference” (F2).*

Here there is a sense that government is important; some level of regulation is valued but only so long as it is minimal. These comments reflect on the ways in which other values – of self-direction, for example – impact how people think about government and what kind of roles various levels of it should play in regulating or supporting agriculture. They also suggest that there is no clear collective value regarding governmental engagement in this community.

There is evidence of some patterns in terms of associations between values held by individuals within the community. There was an association between values of universalism and pro-government attitudes (4 pairs) and, similarly, one between anti-government views and self-direction (5 pairs). Arguably reflecting similar logics, there was a stronger association between values of knowledge exchange and universalism than between knowledge exchange and self-direction. Finally, there seemed to be somewhat more of a tendency for people to have values of universalism OR self-direction rather than both.

Whereas 7 people mentioned only one value or the other during the course of their interview, only 4 people expressed both values in the same interview.

Two interviewees reflected different associations than those evident in the majority of interviews. These two expressed a combination of values that were not present in other interviews. For example, both expressed valuing universalism and very minimal governmental intervention in agriculture. All other interviewees who mentioned universalism expressed valuing stronger government. These two interviews that defied general patterns are interesting and, I think, important to acknowledge as examples of the ways in which values can be combined in what may seem to be counter-intuitive ways.

There was no grouping (rancher, annual grower, perennial grower) within which all people articulated valuing the same thing. However, the majority within all categories value self-direction: three out of five ranchers, three out of four perennialists, and two out of three annual growers. Ranchers were the only group in which more people indicated valuing universalism (four) than self-direction (three). As a category, ranchers also had the least antipathy for government. In contrast, the majority of both annual and perennial growers expressed anti-government values.

### **3.2 Climate Perceptions**

The majority of interviewees described the general climate of Delta County as relatively dry and arid, and indicated that inter-annual variability impacts their crop production in some way. However, less than half of the interviewees (five) considered climate factors to be of particular significance to their agricultural operations. Three people

referred to Delta County as a “high desert” climate and six specifically characterized the general climate as highly variable. Five people identified climate as a significant factor citing a number of different reasons including: frost, the impacts of microclimates, implications for determining growing season length, drought, and soil temperatures. People who stated that climate was not much of a consideration for them said that issues such as the saltiness of soils, product marketing, and the timing of high country permits, which allow grazing on federal lands for specific periods of time, had a much larger impact on them and their business. See Table 2 in the appendix for counts.

Although seven people spoke about the impact variability has on their crop production or water and stocking rate, only two people said it is something they pay a lot of attention to and think about trying specifically to mediate. In speaking about variability one of these interviewees said, *“It’s pretty significant. It’s something I definitely pay a lot of attention to”* (F5). A third interviewee remarked that variability has a big impact. However, it is not something that can be mediated in his specific location because it is not economically feasible to do so. He explained that the potential gains in fruit production from installing windmills or heaters to moderate late frosts and cold winds do not outweigh the costs of such infrastructure:

*“I have no physical ability here to alter what the weather does. There are things that people do – they have windmills and stuff like that – but it’s not economically feasible to do that on this vineyard here. It isn’t a workable solution”* (F12).

All but one of the interviewees who pointed to variability as having an impact commented on having noticed some kind of change in climatic factors in the last ten to fifteen years (see Table 3 in the appendix). In total, nine interviewees mentioned having noticed some kind of change in the climate or environment during this time period. Seven of

the nine mentioned observing more than one changed environmental or climatic factor. The most commonly mentioned changes included the perception that temperatures were increasing, winter getting milder, and snowpack melting earlier.

Other perceived changes included: earlier start to the growing season and earlier blooming for fruit trees, increased variability in weather, less moisture overall, and an increased occurrence of violent storms. Two stories about record-breaking events were also shared. The first is that for the first time on record, in 2015 the Crawford reservoir was filled by rainwater rather than snowmelt. Secondly, six or seven of the earliest peach blooms on record have occurred in the last decade. The earliest ever recorded occurred in 2014. Only one person who spoke about some change she had noticed expressed distinctly anti-government values. The majority talked about seeing a role for government, rather than being neutral.

There were some differences in climate perceptions by category. All annual agriculturalists (three) were neutral in terms of whether they perceived climate and variability to be particularly challenging, and more than half of the ranchers (three out of five) found climate to be challenging. All perennial growers (four) stated that variability impacts their crops. Ranchers were the only group to perceive changes in winter conditions and snowmelt.

### **3.3 Climate Change**

The majority of interviewees overall and within each category expressed believing in climate change. See Table 4 in the appendix for counts. Two of these people expressed being concerned about the implications of climate change for their children and future generations.

Two believed it would mean increased variability, which they consider a challenge. An orchardist articulated this concern saying,

*“Everybody says its (climate change) going to help us because it’s warmer and while we might tend to bloom earlier, the variability of having that arctic clipper come down at the wrong time is certainly one of the biggest worries” (F5).*

Another interviewee expressed the above-stated opinion that warmer temperatures resulting from climate change may in fact benefit farmers in Delta County saying,

*“As long as there is water, climate change would be a benefit because the warmer temperatures would make the growing season longer” (F4).*

Reflecting on the extent to which the agricultural prospects of Delta County are connected to and impacted by processes at larger scales, another interviewee speculated that the particular topography of Delta County might position ranchers in the area to gain a competitive advantage. He explained,

*“It’s not clear that climate change here in this area is going to be a real problem. In a purely economic way, if there are more droughts out further in the Southwest and we have a little more rain we have a great hay market and so we might have a competitive advantage. The mountains here are a rich resource of grass and even in drier conditions that grass is going to be there” (R6).*

This interviewee added that he has confidence in agriculturalists’ ability to adapt given the relative slow rate of change:

*“I think it [climate change] will tend to be slow enough that you can adapt to it as you go” (R6).*

Multiple people (five) spoke about the uncertainty and “bigness” of climate change saying that it is either not something they think about at all, or something they think about but do not consider in agricultural planning because it is too complicated and unpredictable. When asked whether climate change is a planning consideration one interviewee said,

*“No. And the only reason I say no is because I just have no idea. If I were special in the sense that I could interpret what climate change is really doing then sure I would. But I can't, I don't know what it is going to do” (F12).*

Three people commented on taking deliberate measures to address climate change. A third stated that his practices of organic farming techniques, and emphasis on crop diversity, already promote the resiliency necessary to meet any potential specific challenges of climate change:

*“I think because we grow such a diversity of crops global warming doesn't matter as much for us because that's the plan from the beginning – to grow a diverse amount of crops to safeguard against that. This crop is going to do well; this crop is not going to do well. Sometimes because of a bug, a storm, a singular thing or multiple things that destroy a crop. So if you have a diversity of crops you are safeguarding against whatever the cause” (F1).*

Three interviewees said they think climate change is not real, or a “*big hoopla to get us off coal*” (R8). Another said that discourse around it is a political ploy to “*regulate and control farmers*” (F3). The third person referred to climate change as “*hocus pocus*” saying the climate changes every 50-60 years and thus the ‘changes’ attributed to global climate change are totally blown out of proportion.

Several similarities between the three who do not believe in climate change are apparent. Two directly expressed anti-government attitudes. The cattle rancher did not articulate a value *vis-a-vis* government but said that pressure from environmentalists is the biggest challenge facing ranchers in the area. All three of these interviewees indicated strong values of self-direction, especially independence. None of them mentioned valuing universalism or knowledge exchange. Although not about values, another interesting parallel between these respondents is that all were engaged in multi-generational agricultural operations and none had a background including some kind of formal education in science or agriculture.

Interviewees who believe that climate change is real relate to it in personal terms. They expressed concern for what it might mean for the environment, and especially for their children. One interviewee articulated this saying,

*“It [climate change] really impacts me when I think about my kids. I hope my kids can ski and go to the beach and surf and hunt where we’ve hunted” (F2).*

Those who are planning for an agricultural future increasingly affected by climate change stated that for them the phenomenon means changes in the local climate, including increases in temperatures and variability. One person said that it means a *“fulcrum point between variability and change”* (R7) or a change that is beyond the envelop of historical variability.

The rancher trying to mediate risks of climate change has done so through focusing on building soils and conserving water by replacing open ditches with a pivot sprinkler system. The perennial agriculturalist, an orchardist, has installed windscreens, specifically plants trees in the warmest parts of his land, and has begun to select only frost hardy fruit varieties. The annual grower relies on having a diversity of crops, which is a strategy for contending with any kind of change or environmental pressure.

The distribution of beliefs and attitudes regarding climate change is similar across categories. All but one of the individuals who had observed some change in the environment or climate believe in climate change and all but one who believe the phenomenon is real have observed some local changes. Within each group there was one person who did not believe in the phenomenon of global climate change, and also one person who is deliberately taking steps to mediate climate change. A higher percentage of ranchers find climate change to be too complicated and uncertain to plan for or try to directly address.

### **3.4 Strategies for contending with climate and variability**

All interviewees mentioned one or more production strategies they rely on to contend with the particular climactic conditions of the area. Some combination of management, behavioral/attitude, and social/political strategies were important for the majority of people. See Table 5 in the appendix for a summary of responses. Production strategies refer to concrete technical measures that have to do with land and crop or livestock management. Management strategies generally refer to strategic decision-making, behavioral/attitude to personal attitudes or behaviors, and social/political to some form of association or reliance on networking and relationships. These categories are my own, but informed by an adaptation typology developed by Barry and Skinner (2002). They sort strategies according to the following categories: technological developments, government programs and insurance, farm-level production practices, and farm-level financial management. Interviewees rely on the following specific strategies.

*Production strategies:* Water storage and conservation strategies including installing drip irrigation or gated pipe and spring systems, building water ponds, and using water tanks were talked about by half (six) of the interviewees. The second most frequently cited production strategy was having crop diversity (mentioned by four people). Other strategies include: diverse sourcing of crops for operations that make value added products in addition to raising crops themselves (wine and apple cider); carefully selecting frost resistant fruit varieties; using windscreens, shade tarps, greenhouses, and heaters to slightly modify conditions and protect plants; rotational grazing to build soils and optimize pasture growth.



*Management strategies:* Six out of eleven of those who spoke about the importance of financial management practices in ensuring viability of their operations. “Good” financial practices were about saving in good years to make it through the bad years and generally living a relatively frugal lifestyle. Other commonly mentioned management strategies included developing diverse marketing streams and retail outlets, and intentionally staying away from commodity markets. There was a split in terms of interviewees’ views regarding the value of tapping into grant opportunities and research collaborations to either gain access to capital or specific knowledge to help bolster production. Five people had either gotten grants (mostly from the National Resources Conservation Services (NRCS) to install sprinkler systems) or partnered with a research university to have some kind of research – on soil, water systems, crop viability – done on their land. Some of those who did not utilize these resources expressed that it is important to not receive “handouts” and do it on your own. This was articulated by one interviewee who said, “*Businesses need to support themselves and not look for handouts*” (F4). Others seemed to merely not see the need or think the benefit of such endeavors would be worth the time and energy needed to do the paperwork.

*Behavioral/attitude strategies:* There was similarity in terms of what kind of attitudes interviewees discussed as being critical to being a successful agriculturalist in Delta County. More than half (six out of eleven) of those who spoke about behaviors and attitudes said success depends on being willing to work hard, half of the respondents (five) talked about the importance of being frugal and restrained, and almost as many people (four) spoke about the importance of being observant. Interviewees spoke about the need to be constantly monitoring and paying attention to environmental conditions and your land. As one interviewee said, “*It is all about paying attention to what is in front of us and what our role is*”

(F2). Three people added to this, saying that you have to be both observant and open-minded or willing to try new things as a way of adapting to changes. One interviewee summarized these strategies and explained their connection:

*“Being observant and really paying attention to the land and the grass and the water and the health of the animals and how it all works together is really important. And then being able to remember from year to year what works and what doesn’t and being able to take action on that and not get in traps of being so busy or in a rut of what you do that you can’t adapt and change” (R6).*

One older rancher reflected on the value of being willing to learn new things and change saying,

*“Personally I think you have to be open-minded. It seems like the longer you are in agriculture the more set in your ways you get. It was certainly easier for me when I started ranching and tried new things because there wasn’t a history of how to do things. And now I am the old guy who doesn’t change because I think I have it figured out. It’s the willingness to admit that there might be a better way” (R10).*

This kind of flexibility was clearly important to a minority of interviewees. It was not mentioned at all by the majority, suggesting a divide in terms of its perceived value as a behavioral strategy.

Several other interesting attitudes were mentioned by one or two people: sacrifice, high tolerance for risk, ingenuity and patience, calm, wanting to be your own boss and a passion for the lifestyle such that you are willing to stick it out through bad years. One thing that was not mentioned at all was collaboration beyond the act of exchanging information and swapping stories.

*Social/Political:* Half of the interviewees (five out of ten) who talked about in some way tapping into relationships or networks spoke about the value of exchanging information and talking through things with other agriculturalists. This is a social strategy as it depends

on building and utilizing a peer social network to contend with environmental conditions (Berkes and Jolly). As one interviewee said, “*It’s all about the personal relationships you have with people*” (R6). This is a complicated strategy that not all people have the same access to. The interviewee explained that intergenerational relationships are critical to knowledge exchange and learning how to be successful. While emphasizing that building and maintaining relationships with other agriculturalists is critical, he expressed some frustration at his own experience of encountering limitations:

*“I definitely glean information from ranchers to some extent but I could imagine a much richer exchange of knowledge. It’s competitive to some extent but I could imagine a much richer exchange of information from old timers to younger people. A lot of that happens within families so you see a young rancher coming up within a ranching family has access to an incredible store of information gleaned over generations that a newer person just doesn’t have. That is an advantage that they have”* (R6).

This comment reflects on the extent to which knowledge exchange is somewhat fraught, and not necessarily a robust form of collaboration. Most people value it and practice it but some see potential that has not yet been realized within the community. As discussed previously, a number of others prefer to be independent, and do not see the value in strategizing with peers. When asked whether she talks with peers very often one rancher said,

*“Not really. Ranchers are still pretty independent so everybody has a different program and way to graze. We do a lot of things in common but I don’t know that we rely on each other’s information. Everybody just kind of does their own thing. We are on the same basis but not, it’s very individual”* (R8).

The other relationship or affiliation-based strategy that came up was participating in national political advocacy and lobbying organizations concerned with farmers or ranchers rights. These include the Cattlemen’s Association and Farmers Union. Two people, one rancher and one orchardist, spoke about being members of such organizations as a way of trying to keep agriculture viable. Neither of these respondents spoke about sharing

information with peers. Both expressed anti-government values. Several people sought out spaces to exchange information on their own and still other participated in local and national trade networks or organizations including the Valley Organic Growers Association (VOGA) and the National Association of Onion Growers. There were some significant differences among interviewees in terms of their relationship to this knowledge exchange strategy.

By category, all perennial growers placed significance on two management strategies: financial management and maintaining diversity in marketing and retail outlets. All annual agriculturalists had received grants and technical assistance from research institutions. One person partnered with a university team to do research on the impacts of drip irrigation on onions. He explained that the results had been very positive and he had installed a drip system as a result. This has helped him conserve water and stretch what he does have in dry years. The other two individuals had received grants to build greenhouses. There was no single strategy practiced by all ranchers. Despite the differences between groups, a number of strategies were practiced across the board: water conservation or storage, financial management and frugality, and peer knowledge exchange. One individual within each group also relied on talking to experts.

## Chapter Four: Discussion

### 4.1 The Core Story: Common Values, Perceptions, and Practices

The community of agriculturalists represented in this study share an identifiable set of common values, and a core story about what it means to practice agriculture within the context of Delta County. This begins with descriptions and understandings of the climate and environment. People recognize that they operate within environmental conditions characterized by general aridity, microclimates, and inter-annual variability. As one interviewee described it,

*“The Mountains create anomalous weather. It is not predictable at all. Anything can happen. There are microclimates all over the place” (F12).*

While much of the County is somewhat environmentally marginal and challenging to grow crops in, people value the landscape and quality of life it offers. An interviewee spoke to this saying,

*“If it were not for the beauty and quality of life in the area I wouldn’t put up with the high PH and salt and clay. I would go to Iowa where the soil is great” (F1).*

There is general agreement that climate factors including variability and the impacts of microclimates affect production.

Microclimates are a significant feature of Delta County because of its complicated topography and location at the base of the Rocky Mountains. One orchardist highlighted the extent of difference that can result from the presence of microclimates reporting that there is a 10-degree temperature difference within half a mile of his property. This difference is such that his neighbor to the south can grow fruit trees that he cannot. Several growers reported

similar situations noting that what they could and could not grow was particular to the precise location of their property as well as features including airflow and air drainage.

Describing his land one grower commented,

*“It’s a little microclimate that lets us cheat Mother Nature and grow fruit; if we were a mile in either direction that might not be possible” (F5).*

Another spoke about the significance of slope orientation saying,

*“The people on the other side of the Gunnison River on south-facing slopes in some years are able to have varieties I can't have because I am on north-facing slopes.”*

Microclimates impact perennial growers the most because of the sensitivity of their crops.

Still, annual growers as well as ranchers recognized the prevalence and significance of them in shaping conditions for agriculture in Delta County. Like most places in the West, aridity is its own challenge and addressing it hinges on water rights. The legal terrain of water would need to be the subject of a separate thesis.

The significance of historical variability, microclimates and topographical complexity contribute to the low level of risk perception regarding climate change, adding uncertainty to an already uncertain phenomenon. Microclimates contribute to how agriculturalists in this study perceive climate risks and what kinds of production strategies they employ in their operations. They may also be a mediating factor in general climate risk perception as subtle climatic changes throughout the region impact different specific locations quite differently. Infrastructure such as greenhouses and pivot sprinklers also contribute by decreasing perceptions of risk associated with climatic factors (Niles et al).

Even though significant variability has long been a feature of the climate in the area, community members have noticed changes that extend beyond the envelop of historical variability. The majority of people accept climate change to be real and have also observed

changes in the environment that deviate somewhat from historical patterns. General increases in temperatures over the last ten to fifteen years have been noticed by people representing all types of agriculture. However, the two – global climate change and observed change – are not necessarily associated and most people are not sure whether they represent anomalies, or a new trend. For the community of agriculturalists interviewed in this study writ large, climate change is perceived to pose little direct risk to their operations now or in the future. Neither is it of much concern as a future threat. This finding contrasts with the literature that suggests a strong correlation between beliefs about climate change and perceptions of future risk (Takahashi et al; Saleh et al; Arbuckle et al; Niles et al).

It points to the significance of a cultural orientation toward individualism. Values of self-reliance and independence de-emphasize risks that are beyond the power of individuals to control or fully understand. It also aligns with arguments about the extent to which personal experiences and expectations about climate shape perceptions of change. Weber found that even those whose livelihood is directly impacted by weather and climate (including farmers and ranchers) tend to underestimate the likelihood of climate change impacting local environments because they base assessments on what they have historically experienced (2010). A number of other researchers have similarly argued that past experience plays a significant role in shaping expectations, which subsequently inform perceptions of future risk (Takahashi et al; Saleh et al; Leiserowitz). Agriculturalists in this case have experienced and generally come to accept operating in an already chaotic, highly variable, and in a sense unknowable climate. Global climate change may not seem to represent very different conditions.

Self-direction, and specifically independence, is a strong core value for community members. It tempers agricultural practices and climate risk perceptions. Universalism, conceived of as protecting the land and preserving natural beauty, is also important to the community. So is talking about conditions and practices with peers. These three values – of self-direction, universalism, and knowledge exchange – are shared across categories of rancher, perennial agriculturalist, and annual growers. They also transcend political values and perceptions of climate, indicating that they are core to the culture that shapes the community. Among them, self-direction has the greatest influence. These collectively held values exist in relationship to individual beliefs and values regarding the appropriate role of government, adaptability, tradition, the prospects of future generations, efficiency, sustainability, and willingness to sacrifice. They also underlie the shared set of agricultural practices community members rely on to stay viable. These include: managing money carefully and conservatively, being willing to work hard, managing water wisely, and informally exchanging information. For all types of operations – ranches, perennial, and annual – management as well as behavioral strategies are as important to being successful as production practices. These strategies reflect on cultural values of self-direction and restraint. External support is neither expected nor commonly desired.

#### **4.2 Points of Values Divergence**

Some important divergences within the community also exist. Although the majority of people believe in global climate change, a minority strongly believes it is a political hoax. With one exception, those who do not believe in climate change have not observed changes



in the environment. This may reflect the correlation between beliefs and the perception of biophysical change. High levels of belief in climate change tend to be correlated with perceptions of environmental change while low levels of believe correlate with little or no perceptions of change (Niles et al).

There are also a wide range of beliefs and values regarding government. Those who do not believe in climate change generally value limited and constrained governmental involvement. It should be noted that despite expressing anti-government sentiments they seem to appreciate governmental action when it “protects” farmers’ interests. They take issue with the federal government, decrying environmental regulations and like the County government so long as it keeps regulations to a minimum. As one interviewee stated, the ideal role for county government is to,

*“Not pass so many regulations that we can’t make it. They have to keep the regulations down and keep businesses here that support ag” (F11).*

This relationship between ideological conservatism and climate change denial or skepticism confirms findings presented in other research about the ways in which those who deny climate change espouse talking points generated by the conservative right in an attempt to stall climate action (Takahashi et al).

Those who do share a value for some level of government involvement in agriculture nonetheless differ in exactly what they deem to be ideal or appropriate. Some believe the role should be relatively limited. As one interviewee said,

*“The County [government] does have a role – don’t kick us out, don’t make life more difficult for us” (F5).*

Some maintained that the county government’s hands off policy and support for being a “right-to-farm county” are all it should be doing. Others wished it would do more to promote

local agricultural products and participate in county-level economic development. Still others expressed frustration with current county policies expressing a desire to see the county aggressively regulate certain activities such as oil and gas leasing as well as residential development. Only one person spoke directly about seeing a role for the federal government. This was to be heavily involved in providing money for infrastructure and irrigation improvements as well as shaping climate action because “*on the local level people just don’t see the big picture and the interrelationships*” (R6).

### **4.3 Nuances in Climate Risk Perceptions**

There is also some important diversity in the narrative about what environmental variability means in relation to agriculture. Some of this has to do with the type of agriculture practiced – the exact timing of the last spring frost matters less to ranchers and annual farmers using greenhouses than it does orchardists – and some of it with individual values and beliefs. Perspectives on the significance of variability ranged from the notion that it is “the big constant” that has always been a fact of agriculture and thus not something to try and mediate, to the perspective that it is “pretty significant” and something to be directly engaged through a variety of strategies. Specifically, inter-annual variability was discussed as being a challenge in terms of its impacts on moisture, heat-degree days, irrigation, and the temperature of soil. Ranchers mentioned impacts on water levels and irrigation; perennial agriculturalists talked about moisture in terms of how it moderates temperature and emphasized the significance of both the timing and intensity of temperature on plants and trees.

For a majority of people variability is seen to impact their practice but not related to as a challenge that can or ought to be directly mediated. It is just a fact of life in the County, and thus something that is not perceived as a particular threat. Farmers and ranchers have learned how to survive the bad years and make the most of the good. Understandings of the climate and the “normality” of variability are transferred from one generation to the next. As one annual farmer commented,

*“I don’t think we have ever experienced normal. You talk to the old timers around here and occasionally a year seems normal but even the normal years there is some time of year that things get out of whack relative to the average” (F1).*

Individual attitudes are another principle way of accepting variability as an inherent part of what it means to practice agriculture in the County. An older rancher who had been working on the same piece of land for over forty years explained,

*“I said I thought I had seen everything in raising cows and I learn something new every time. That’s just the same in nature - there are the seasons but it is different every year. You have a general knowledge but you can’t just dial it in and have an ideal because it is different every year” (R8).*

Another said, *“The climate is reality regardless of my planning”* (F3). For those who understand climate (and variability) to be such an immutable reality there is little sense in planning to mitigate the challenges that may be associated with it.

Some people, however, do identify climate as a principle concern and point of consideration in planning. This is especially true for those who grow fruit, most of which is highly sensitive to frost and temperature changes. As one orchardist said, *“The things that give me grey hair as a grower are climate, spring frost.”* This grower directly engages the challenge primarily through planting in specific places and using windscreens. A perennialist who grows grapes said,

*“The biggest challenges for farming here are weather first, and then water ... sometimes the weather will determine whether you have a crop or not. Sometimes it freezes pretty late here and we lose it. If the buds are swollen to a point or even opened and you get a substantial freeze – then that kills the buds.” (F12).*

Water was of particular concern for ranchers, most of who operate in higher elevations of the county that are farther away from the river beds and thus have less secure water rights.

Variability for them is a concern in terms of moisture as drought years mean less water and less grass for their livestock.

Believing in global climate change and noticing some environmental change beyond “normal” variability does not translate to heightened perceptions of climate risk. One grower who believes in climate change and has seen “*a sign wave of change in the ecology of the land*” in the last fifteen years rationalized,

*“The climate is always changing. From the farming stand point climate change is just maybe an easy way to describe what would happen to some degree anyway” (F1).*

The majority opinion is that the phenomenon is just too big and too uncertain to plan for.

However, some people in the community are concerned that too little action is being taken.

As one rancher commented, “*We kind of have our heads in the sand thinking we can wait*”

(R10). Three members of the community, one orchardist, one annual grower, and one grass-

fed beef rancher are deliberately taking steps to mediate the risks of climate change. For the

orchardist this involves selecting more frost resistant fruit varieties and planting in specific

places to avoid cold spots. For the rancher it means switching from flood irrigation to pivot

sprinklers and focusing on building soils. Several others implement similar strategies as a

means of cultivating resiliency, contending with the already variable climate of the area, and

operationalizing their own environmental ethics. However, they do not directly relate to these practices as forms of climate change risk management.

#### **4.4 Effect of Operation Type**

Type of operation – perennial, annual, ranching – has some impact in shaping community members climate perceptions and strategies. Production strategies vary the most by type of operation as different crops (or livestock) have particular needs. There are some differences in terms of management practices as well. For instance, all perennial growers interviewed find it important to maintain diversity in terms of retail outlets and marketing strategies. All annual farmers have found it valuable to tap into grants and research collaboration opportunities for infrastructure development and improvement. In terms of climate perceptions, there are some distinctions in terms of what particular changes have been noticed. Ranchers reported noticed that winters have gotten milder and spring snowmelt is occurring earlier. Farmers (of all kinds) have noticed that the growing season seems to be starting earlier, fruit trees have been blooming earlier, there has been an increase in the occurrence of violent storms, and generally less moisture. Still, some change has been noticed by at least half of the interviewees in each category. This line of difference does not seem to impact values. More ranchers in this study expressed progressive views but that likely has more to do with selection bias than type.

#### **4.5 Vulnerability and Adaptive Capacity**

Climate change is impacting and will continue to impact Delta County, requiring targeted adaptations across the agricultural sector. Scientific evidence as well as interviewees' observations confirm that weather patterns and climatic conditions have already begun to shift subtly. The rate and severity of future impacts are unknown. This is certainly challenging, and is cited by community members as a primary disincentive to deliberately engaging climate change through building adaptive capacity and taking proactive action. Scholars, however, argue that uncertainty is not an inherent limit to adaptation. Pointing out that everything – politics, culture, economics – involve uncertainty, Adger and colleagues suggest that robust decision-making processes can generate viable plans even in the absence of precise information (2009). According to this argument, vulnerability comes not from having inadequate access to complete information, but from underestimating risk (Adger et al, 2009).

Surfacing values, existing practices, and current perceptions of climate risk is critical to assessing community capacity and vulnerability in relation to future change. Of course, assessments can be made through a number of different conceptual frameworks, each of which produces slightly different conclusions (Biesbroek et al). This research draws primarily on a values-based (O'Brien and Wolf) and community vulnerability assessment approach (Smit and Wandel). These approaches do not provide a formula for what constitutes adaptive capacity and vulnerability; rather, they illustrate the extent to which they are context-specific and culturally informed. Findings indicate that there are a number of points of strength and challenge for the community that are reflected in practices but grounded in values and risk perceptions.

Some core values held by community members promote resilience and capacity; others function as barriers to adaptation. Values of universalism encourage careful land stewardship, which is reflected in widespread practices that encourage ecological as well as production resiliency. These practices include water conservation, building soil integrity, maintaining crop diversity, and strategically utilizing windscreens and greenhouses. Valuing adaptability is also a point of strength for some members of the community. One rancher summed up the importance of this to adaptation saying,

*“Everything changes in ranching - labor markets change, economics, the breeds, and the weather can change - so adaptability and being able to observe and react and change your practices is I think really key to sustainable and successful ranching” (R6).*

Adaptability underlies the critical behavioral strategies of being observant and flexible. The value for and practice of tapping into social networks to exchange knowledge is another point of strength. Finally, there is a certain kind of resiliency that comes from community members’ willingness to accept that some years will be bad. They moderate their own expectations and strategically use resources to prepare for years in which production is a bust.

However, there are also a number of vulnerabilities that may endanger community members’ ability to adapt successfully to future climatic change. The culture of individualism that shapes this community is one of them. Individualism generates skepticism of collective effort as well as governmental and institutional collaboration (Leiserowitz). The significant role that collectivity, the opposite of individualism, has in promoting resiliency and capacity has been well established. Claudia Isaac provides a helpful definition of community resiliency arguing that it depends on the capacity of communities to “help each other” and “collaboratively generate social, political, and physical solutions” (2017, 211). Climate change literature offers similar understandings emphasizing that adaptive capacity

relies in part on the ability of people to build resilience through collective action (Folke; Adger, 2010). Although the prevalence of peer information exchange is a promising pathway toward greater collaboration, collective action seems to be neither highly valued nor practiced in the community studied here. One older rancher raised this concern in saying,

*“It's easy to see something inspiring that is going on 100 miles away but if you're next door neighbor's doing it it's hard to admit that your next door neighbor has it figured out better than you do” (R10).*

The majority of the management and behavioral strategies people attribute their own success to – including being frugal and working hard – reflect strong values of self-reliance. The strength of this value minimizes peer collaboration, and encourages a general distrust of government. Scholars argue that governmental entities at all levels have an important role to play in stimulating adaptation, increasing knowledge exchange, providing resources and coordination, and confronting existing barriers through policy development (Biesbroek). In rural communities, local or county governments have an especially critical role (Agrawal).

Low levels of risk perception are also a significant point of vulnerability (Adger, 2009). At the community and individual scale proactive adaptation depends to a great extent on peoples' sense of urgency (Grothmann and Patt). Among the agriculturalists represented in this study there is widespread belief in climate change, but little sense of urgency associated with it. People attribute their own perceptions of the (low) direct risk climate change poses to the complexities of the surrounding terrain and uncertainty of predictions. Research suggests that such perceptions are also significantly shaped by peoples' past experience (Takahashi et al; Weber). In this context, people have experience contending with already high levels of variability, and subsequently normalizing chaotic weather. As mentioned previously, this acceptance contributes to resiliency in that it moderates



expectations and encourages preparing for bad years. Through decreasing perceptions of risk it also in some ways acts as a barrier to adaptive action.

Past experience and prior knowledge also highlight another vulnerability: reticence to change. Especially in multigenerational operations, agriculturalists inherit understandings of how to do things from their forbearers. While this certainly serves as an asset in some ways, it can also encourage a form of path dependency. One farmer spoke to this particular barrier saying,

*“There is so much social stuff built into how you farm and what you farm. It plays a really big role in the adaptation to climate change. You don't want to make a change because your granddaddy did it this way and his granddaddy did it this way” (F1).*

An old rancher who shared a similar opinion also suggested that most agriculturalists in Delta County are not going to be proactive in adapting to a changing climate. Articulating what may actually be the keystone of adaptive capacity – individual and community willingness to change – he rather pessimistically concluded,

*“I think it almost takes a crisis to get most people to change. It's not just older people. If you grew up on a ranch, you inherited those ideas of the way it should be done” (R10).*

Findings presented in this thesis about the range of values and practices people rely on, which include some that revolve around adaptability, indicate that there is reason to be more hopeful. Still, the illustration of real and concerning community vulnerability that has to do with attitudes, and the values that shape them, is a good one. Further research should be done to identify adaptive pathways that would be appropriate and most likely to be successful given the particular context of this community.

## Chapter Five: Conclusion

As the impacts of global climate change become more acute, agricultural systems will need to adjust. What is needed will vary by region, community context, and the severity of climate changes (Howden et al). Governmental and institutional actors may be critical in facilitating adaptation at all scales (Biesbroek; Agrawal), but communities and individual farmers are and will continue to be on the front lines. Understanding farmers' adaptive capacities and practices can help shape adaptation initiatives to achieve community buy-in and positive outcomes (Crane et al). Where change is incremental (in contrast to extreme events), successful adaptations tend to be those that build on and are integrated into existing practices (Takahashi et al; Smit and Pilifosova). They also tend to be those that are developed with attention to value systems and cultural context (Adger et al).

This thesis provides insight into the particular context of one community, but its methods and findings about the extent to which values shape both risk perception and agricultural practices are more widely applicable. Culture and values have been proven to play a significant role in shaping risk perception (Leiserowitz; Douglas and Wildavsky; Saleh et al; Weber; Adger et al), which is a cognitive building block of adaptive capacity. My findings indicate that existing agricultural practices are similarly influenced. They also suggest that environmental conditions – specifically the prevalence of microclimates, topographical complexity, and significant preexisting variability – play an important role in influencing perception and climate management. This influence is a promising area for further research.

## Appendix: Saturation Tables

**Table 1. Value Codes by Category and Total**

Value	Ranchers	Perennial Agriculturalists	Annual Agriculturalists	Total # of interviews in which mentioned	Total mentions
Self-direction	3	3	2	8	16
Universalism	4	2	1	7	8
Knowledge Exchange	3	2	1	6	8
Anti-government	1	3	2	6	8
Government Role	2	2	1	5	6
Adaptability	3	2	1	6	6
Tradition	2	2	1	5	6
Future of Children	2	1	1	4	5
Efficiency	0	2	1	3	5
Sacrifice	1	1	1	3	3
Sustainability	2	1	0	3	3

**Table 2. General Climate Perceptions by Category and Total**

Climate Perception	Ranchers	Perennial Agriculturalists	Annual Agriculturalists	Total # of interviews in which mentioned
Delta County has highly variable climate	2	3	1	6
Variability impacts production in some way	3	4	0	7

Climate factors are a significant challenge and consideration for my agricultural operation	3	2	0	5
Neutral regarding significance of climate factors	1	1	3	5
Climate factors are not significant challenge or consideration	1	1	0	2

**Table 3: Perceptions of Environmental/Climatic Change**

<b>Perception of Change</b>	<b>Ranchers</b>	<b>Perennial Agriculturists</b>	<b>Annual Agriculturalists</b>	<b>Total # of interviews in which mentioned</b>
Total who commented on perceiving some change in last 10-15 years	4	3	2	9
Increase in temperatures	2	1	1	4
Milder winters	3	0	0	3
Earlier snowmelt in spring	2	0	0	2

**Table 4: Climate Change (CC) Beliefs and Perceptions**

<b>CC Belief or Perception</b>	<b>Ranchers</b>	<b>Perennial Agriculturists</b>	<b>Annual Agriculturalists</b>	<b>Total # of interviews in which mentioned</b>

CC is real	4	3	2	9
CC is not real	1	1	1	3
CC real, but too complicated and uncertain to plan for or around	3	1	1	5
Deliberately trying to mediate risk of CC	1	1	1	3

**Table 5. Strategy Mentions by Type and Total**

Type of Strategy		Ranchers	Perennial Agriculturalists	Annual Agriculturalists	Total # of interviews in which mentioned
<b>Production Strategies</b>					<b>12</b>
	Water storage or conservation	3	1	2	6
	Crop diversity	0	2	2	4
<b>Management Strategies</b>					<b>11</b>
	Financial	1	4	1	6
	Grants or research collaborations	2	0	3	5
	Diversity in marketing and retail	0	4	1	5
	Stay away from commodity markets	2	1	0	3
<b>Behavioral/Attitude Strategies</b>					<b>11</b>
	Willingness to work hard	3	1	2	6

	Frugality	1	3	1	5
	Observant	2	2	0	4
	Open-minded and flexible	3	1	0	4
<b>Social/Political Strategies</b>					<b>10</b>
	Peer Knowledge exchange	3	1	1	5
	Talking to experts	1	1	1	3
	Membership in political advocacy organizations	1	1	0	2

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