Climate Change: Is Seeing Believing for California Farmers?
Risk Perceptions, Belief Motivation and Social Barriers to Adaptation

Jody L. Strait

ABSTRACT

Many communities have already experienced stressful and at times life-threatening impacts of anthropogenic climate change. As planetary temperatures continue to increase, so will the need for effective adaptation at each societal level. Some communities in the United States, however, are experiencing a troubling paradox: their societies are highly to moderately vulnerable, yet their key decision-makers dismiss the threat of human-caused climate change. A robust body of research suggests that personal experience of climate change, e.g., an extreme weather event, correlates with increased concern, which may correlate to increased political will. Through surveys and interviews, this research tested for rational belief revision in an agricultural community impacted by climate change in multiple ways. My results show that key stakeholders in the study site have low climate-risk perceptions levels and appear to engage in belief-motivated perception, thus limiting local adaptation to climate change. I classify three site-specific social barriers to adaptation, identify trusted messengers and outline local narratives for future climate communication efforts within the study site.

KEYWORDS

California agriculture, social-environmental systems, climate communication, climate denial, political ecology

INTRODUCTION

The Paris Climate Agreement entered into force in 2016, marking the world's most ambitious effort to minimize disastrous impacts of climate change and prepare for some now inevitable (Davenport 2015*;* United Nations 2016; IPCC 2014). In 2017, California's Governor, Jerry Brown, was credited with filling a leadership void left by Donald Trump following his election as President of the United States (Greenwood 2017; Carden 2017). The state of California, however, represents two halves of Earth's climate dilemma. On one hand, its government is dedicated to environmental stewardship. On the other hand, it remains the nation's third highest fossil fuel producing state (McKibben 2017). To date, California's preparations for climate change are not nearly sufficient to minimize climate change's impacts (CalEPA 2016; Pathak et al. 2018; Reich et al. 2018). Global progress on addressing climate change has been, at best, incremental when an urgent pace is now needed.

Anthropogenic climate change and its attendant planetary exigencies it has led to the creation of a new commodity. Ubiquitous, billions of years old, and never directly consumed—carbon sequestration. 70 percent of nations to the Paris Agreement identified agriculture as a key pathway to greenhouse gas (GHG)[1] emissions reductions (FAO 2015; CGIAR). California established a climate change task force for its agricultural sector in 2006, and more recent efforts have included the Department of Conservations Sustainable Agricultural Land Conservation Program. Maps of funded projects since the program's initiation in 2014 show little to no engagement in some parts of California's Central Valley, where most of the state's prime farmland is located (SALCP 2017). Why is progress so slow in a region synonymous with 21st century trailblazing and progressive thought? The question above, put differently: What are the barriers to climate action?

[1] The U.S. Nationally Determined Contribution (NDC) defines GHGs to include the following: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulfur hexafluoride (SF6) and nitrogen trifluoride (NF3) (US INDC 2015).

Consider the seminal paper "Are there social limits to adaptation to climate change?" from a 2009 edition of *Climate Change*:

> It has been suggested that values centered on pro-environmental, ecocentric and altruistic orientations can and do give rise to actions focused around long-term sustainability (e.g. Fransson and Gärling 1999; Nilsson et al. 2004). However, these values currently neither reflect mainstream worldviews nor underlie present societal structures and institutional arrangements, which in turn act as limits to public engagement in adaptation to climate change (and indeed mitigation of emissions) (Dobson 2003; Horton 2005).
>
> Adger et al. 2009

Several other studies have also found the link between climate perception and action. Bord et al. 2000, Krosnick et al. 2006, and Jenkins-Smith et al. 2010 all found that acceptance levels of anthropogenic climate change correlate with public support for adaptation.

For this study, I drew on research from budding climate communication, risk analysis and adaptation planning fields to situate my research of stakeholders in one agricultural community located in California's Central Valley within broader understandings of decision making, collective action, climate adaptation and risk planning. Based on my experience in the study site and study of existing research, I expected to find evidence of low climate risk perceptions despite recent instances of extreme weather events and the state's commitment to climate action. To provide information for future science communication efforts in this study site, I explain the most prominent barriers to adaptation, document community narratives and identify trusted actors for communication and mobilization efforts.

What drives social concern for climate change?

Are fossil fuel industries and their privately funded researchers responsible for most of the US public's climate denial? Despite widespread popular acceptance of this hypothesis within activist circles, recent research argues against this view (Merkley and Stecula 2018). Other experts have dismissed the once widely accepted public irrationality thesis (PIT), which posited an increase in effective science education would end the widening US polarization on climate

change (Kahan 2013; 2014). In 2012, a study by Kahan et al. found "members of the lay public who are the most science literate, and the most proficient at technical reasoning, are also the most culturally polarized." Shared worldviews and "deep stories" have converged over climate change to create a discourse wherein the issue is an identity cue rather than a scientific fact (Hochschild 2016; Kahan 2012). For example, conservative ideology and male gender both correlate negatively with acceptance levels (Weber 2016; McCright and Dunlap 2011; Jenkins-Smith et al. 2010). Further questions considering other factors that influence social concern for climate change are still being explored.

Does vulnerability to extreme weather increase risk perception of climate change?

A multitude of recent studies have observed that acceptance levels of anthropogenic climate change tend to be higher for individuals who have personally experienced climate events[2] (Budescu et al. 2015; Spence et al. 2011; Myers et al. 2013; Rudman et al. 2013; Blennow et al. 2012). Weber 2016 referred to this trend as seeing is believing. Rather than basing opinions on scientific evidence, Weber et al. (2011) found that the general public generally substitutes statistical data with local weather experiences. Research concerning the psychological impacts of extreme weather experiences traces back at least to Kentucky, USA in 1984, when two droughts occurred in 4 years. The researchers found elevated environmental attitudes compared to contemporary standards (Arcury and Christianson 1990).

If seeing really is believing, though, acceptance levels of climate change should have increased with respect to the unprecedented extreme weather events of the past decade, in addition to the strengthened scientific consensus surrounding the issue (Oreskes 2018; Nature 2015). However, instead US Americans[3] have become increasingly polarized on the question of whether human action is changing Earth's climate (McCright and Dunlap 2011; Dunlap and McCright 2008; Weber 2013, 2016; Saleh Safi et al. 2012). One explanation offered for this

[2] For the purposes of this study, the term 'climate event' is used to refer to phenomena that are exacerbated or caused by anthropogenic climate change, such as more extreme droughts, fires, heat waves and floods.

[3] I use the term US American instead of American when referring to U.S. citizens to acknowledge that the U.S. is one of many countries in the Americas. Although an established convention, applying the term American exclusively to U.S. citizens is inaccurate and can be offensive to Americans living outside the U.S. (Dunbar-Ortiz 2014).

divergence is motivated reasoning.[4] Studies have shown that biased cognitive processes can counteract evidence-based belief revision, leading to persistent self-deception (Weber and Sonka 1994; Weber 2010).

A similar question of whether increased vulnerability to climate change correlates with higher levels of climate risk perception[5] has been studied, though to a lesser extent, and even less so in relation to U.S. agricultural sectors (Saleh Safi et al. 2012). The first study of this kind used rural Nevadans as a study population and found the low risk perceptions of climate change were not correlated with increased vulnerability, a troubling result considering agricultures now-prominent role (Saleh Safi et al. 2012). In 2015, Carlton et al. examined the risk perception of agricultural advisors in the Midwestern United States following unusually severe droughts and found no significant effect on climate risk perception, but a contemporaneous study **on** found that experiencing climate change strongly predicted intentions to act on the issue (Budescu et al 2015). Brody et al. experiencing negative effects did not lead to rationally updating to prior beliefs even after climate-related economic losses, such as crop damage, were incurred (2008).

One determinant of the seeing-is-believing correlation may be whether or not the individuals studied were aware that the climate events they experienced were unprecedented. In relation, one 2017 study by Sisco et al., found that a wide range of over 10,000 extreme weather events across the U.S. consistently generated attention on social media from individuals within close proximity.

Study Site: Stanislaus County

Over 50 percent of the vegetables, fruits, and nuts grown in the United States are from California's Central Valley, one of the most productive agricultural regions in the world (CDFA 2017). Stanislaus County is located in the middle of the valley—the county has 1495 square miles of land with 20 square miles of water (Census 2011). The number one industry, agricultural production, surpassed $3.2 billion in 2016 (O'haire and Ross 2016). There are 4,143 farms on 768,046 acres in the county—accounting for 79 percent of its total 969,600 acres (Ibid).

[4] Motivated reasoning is a well-established biased cognitive process wherein an individual's drive to "arrive at particular conclusions enhances use of those [beliefs and strategies] that are considered most likely to yield the desired conclusion" (Kunda 1990). Motivated reasoning can inhibit evidence-based belief revision (Myers et al.).
[5] Climate risk perception is defined here as the level of risk perceived to be presented by anthropogenic climate change.

90% of Stanislaus County farms are male-owned, suggesting the gender demographic found in other regions of the United States is also applicable to Stanislaus County (U.S. Agricultural Census 2012). Stanislaus County is one of the state's lowest average income counties, with an estimated population of 541,560 people (Census 2017).

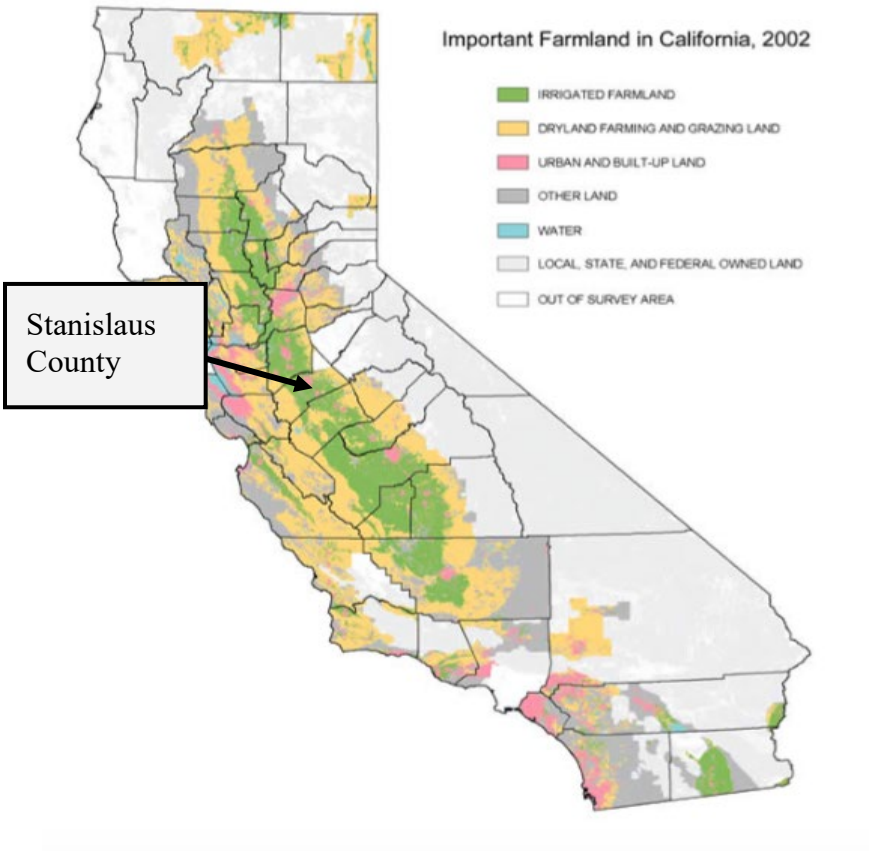

Figure 1. Important Farmland in California, provided by the California Department of Food and Agriculture (2009).

The region was once home to at least 10 Yokut tribes and the Sierra Miwok for thousands of years, with numerous overlapping tribes (Hogue 2016). Settler exploration near the region started as early as 1542 when a Spanish expedition explored Northern California, a dark foreshadowing to the genocidal realities of Spanish and then European colonization, which rapidly decimated California Indigenous populations (Sherburne 1976). The discovery of gold, paired with the burgeoning railroad industry, led to sharp increases in California's settlement.

Some have argued that, in addition to widespread labor exploitation, the circular reinvestment of these newly acquired 'riches' into local economies played a significant role in California's unique economic success, from it came "the conquest of bread" by the state's powerful dyed-in-the-wool[6] capitalist agricultural class (Walker 2001; 2004).

Local Impacts from and Vulnerability to Climate Change

A recent study by Pathak et al. explained how climate change is "expected to continue changing [California] in the future, and justifies the urgency and importance of enhancing the adaptive capacity of agriculture and reducing vulnerability to climate change" (2018). Stanislaus County's agricultural community has already experienced extreme weather events symptomatic of climate change in the past decade, as has the state's industry at large (Pathak et al. 2018). Prolonged and more extreme drought, temperatures, wildfires, and seasonal drift[7] have started to affect the area, as scientists predicted, in tandem with observed warming on a global scale (Luo et al. 2017; He et al. 2017; Mann et al 2016; IPCC 2014; Dunlap et al. 2016; NASA 2018).

Figure 2: Hundreds of "Pray for Rain" signs were spread across Stanislaus County farms during the drought. Source: The Modesto Bee, 2014. In a gesture indicative of a rural bond agricultural communities share, the crop consultant who had these signs made was inspired by similar ones spread across a drought-impacted areas of Texas.

[6] Unlike traditional agrarian societies, California's agricultural economy has been capitalist since its inception, as opposed to having feudal roots.
[7] Here, seasonal drift refers to a change in harvesting times due to changes in temperature and season duration.

The 2012-2016 drought cost California's agricultural economy $603 billion and caused local water shortages and was the worst incidence in 1,200 years of California water history (Griffin and Anchukaitis 2014). During the drought, 1,815 seasonal farm jobs disappeared (Swain et al. 2014; Medellin-Azuara et al. 2016). According to a 2012 White Paper released by the California Energy Commission, the region's moderately high vulnerability level consists of two parts: (1) its land use vulnerability, and (2) its moderately high crop vulnerability.

Past efforts to increase adaptive capacity

In 2008, California passed Senate Bill 375, the Sustainable Communities and Climate Protection Act to provide a framework for local communities to adopt climate centered policy tools (Boswell and Mason 2018).. The law stopped short of requiring the adoption of climate-focused policies by local communities, adhering to a long observed "home rule," or local jurisdiction over land planning. Other laws to incentivize conservation have been enacted, such as allowing the Greenhouse Gas Reduction Fund to be used for water efficiency projects. To date, a total of $141 million from the GGRF has been allocated to California's Department of Food and Agriculture. Adoption in Stanislaus County, though, was proportionally low. Four percent or $553,000 was used for seven water efficiency projects on private farms as of the end of 2017 (CCI).

Study population: Local stakeholders as risk planners and decision makers

Adger et al. 2014 argued that climate adaptation efforts result from the judgements that a society makes about risks. Below, I discuss the purposive sample[8] I have chosen to better understand the risk planners within Stanislaus' agricultural community.

The Farmers

[8] A purposive sample is not random but chosen by the judgement of the researcher based on the population characteristics and study objectives.

Although constrained by many variables e.g., profits and regulations, and informed by other stakeholders e.g., local, state and federal levels of government, academic institutions, private organization and advocacy groups farmers are the primary decision makers in Stanislaus County agriculture. Their beliefs and consequent actions will determine how prepared California agriculture is as a whole for the negative impacts of anthropogenic climate change.

University of California Cooperative Extension

The University of California (UC) was initially founded to teach agriculture, mining and mechanical arts in 1868 (Hayden-Smith et al. 2014). The UC Cooperative Extension program (UCCE) began in 1914 and is part of the Division of Agriculture and Natural Resources (ANR). Since its inception, UCCE set out to minimize risks to California farms and promote successful practices. For example, early extension advisors helped farmers learn to use new farm machinery, increase the egg production of hens and deal with disease outbreaks (Hayden-Smith et al. 2014). Today UCCE employs highly educated farm advisors to facilitate information to and conduct research with farmers and ranchers in counties across California. UCCE's guiding mission statement through 2025 is focused on (1) connecting the UC system with Californians at large and (2) the application of scientific innovations to support food production, economic success, a sustainable environment and science literacy (Figure 3).

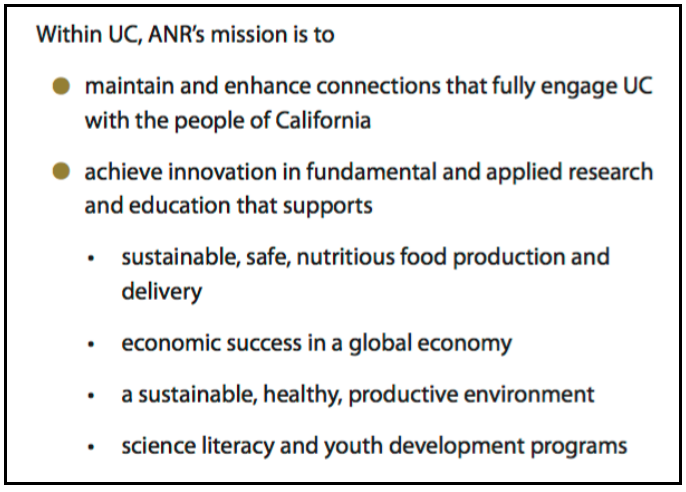

Figure 3. The University of California's Department of Natural Resources mission statement, provided by their 2025 Strategic Vision.

A 2017 internal survey of UCANR scientists called for building climate resilient networks with farmers after finding that only 37 percent of UCANR scientists incorporate climate change into their work with farmers, though 88 percent of respondents believe incorporating climate change is important (Grantham et al. 2017). Respondents noted a fear of alienating their clientele by distributing information on a contentious topic (Ibid). UCCE scientists draw from a diverse funding pool of government, university and producer grants (Figure 4). For example, grants have been provided by the National Institute of Food and Agriculture (NIFA), the U.S. Department of Agriculture's Sustainable Agricultural Resource and Education program, and local almond and walnut boards in addition to grants from UC ANR.

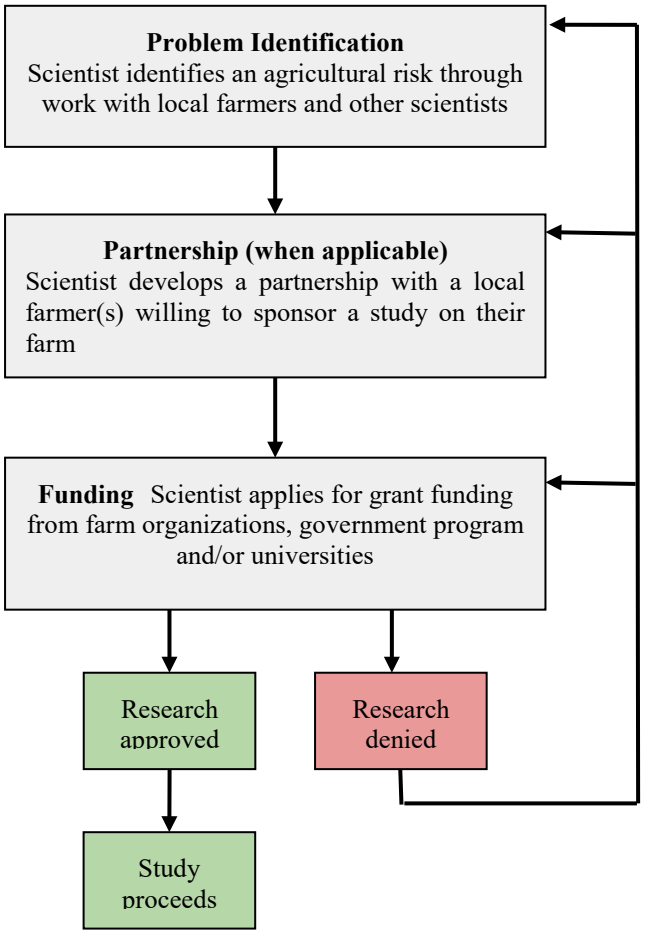

Figure 4. The funding process for Stanislaus County UC Cooperative Extension scientists. Depending on the goal, grants may or may not require scientists form partnerships by conducting their research at a local farm or with professionals across the state.

Stanislaus County Farm Bureau

Farm Bureaus spread rapidly throughout the state in the early 20th century after UCCE began. The Stanislaus County Farm Bureau began in 1919 to "protect and promote family farms and ranches, and to find solutions to problems facing agriculture and rural communities" (CFBF 2018). Its founding stemmed from a meeting in Berkeley between 32 county farm bureaus in an effort to form the California Farm Bureau Federation as a political advocacy extension of UCCE's scientific efforts (Ibid).

Methodology

The first robust systematic review of research on social barriers to climate adaptation was published in 2013 (Biesbroek et al. 2013). Researchers found that "inductive small-n, qualitative case studies that used interviews, workshops and surveys as primary data sources" with a local or regional focus were most often used as a field study method (Ibid. 1122). Lead authors have raised questions over sorting barriers to adaptation into distinct categorizations over concerns that it may omit entire categories (Ibid). Multiple ways to understand barriers exist during analysis; among those include the (1) temporal, (2) social, (3) institutional, (4) normative, (5) cognitive, (6) political and hundreds more (1123).

The definition of "barrier" varies by study. In a comprehensive review, no study used 'if-and-only-if conditions' to qualify specific categorical criteria (Beisbroek et al. 2013). I borrowed the definition provided by Moser, Ekstrom and Kasperson in 2010: A barrier is anything that causes a delay in adaptation, but can be overcome.[9] Generalization specific barriers by broadly applying them from one case to another is challenging because they are often sector-specific and societal specific (Beisbroek et al. 2013). The most commonly identified barriers are social and institutional in nature, as presented by Adger et al. in IPCC-AR4 (2007; Biesbroek et al. 2013).

[9] **Limits** to adaptation are considered to be obsolete by the IPCC because they are defined as lying beyond thresholds that can feasibly be surpassed by the best efforts of human society (Moser et a. 2010). The terms **limit** and **barrier** should not be used interchangeably.

METHODS

I used a mixed-methods approach to survey and interviews the sample of risk planners I identified: farmers, UCCE farm advisors and farm bureau policy staff. I distributed electronic surveys through the listservs of local farm advisors and in newsletters. I solicited additional survey respondents randomly through mailers using a publicly accessible dataset from the office of the Ag Commissioner. For online surveys, I used a customized display logic in Berkeley Qualtrics. A total of 18 farmers successfully completed it.

In the online survey, I asked farmers to identify and prioritize the top three threats to their farming operation in the next 5 and 25 years, and to indicate their support for possible solutions. The pool of threats include drought, economic fluctuation, fuel costs, soil quality, government regulation, increasing temperatures, and invasive species and pests. Each threat option is exacerbated or made less predictable by climate change. Therefore, the pool of solution options for each threat includes "reducing global greenhouse gas emissions linked to climate change" as a choice. The frequency that this option is among those chosen are used as a measure of the respondent's climate risk perception.

I interviewed farm advisers working for UC ANR and local policymakers via phone over the course of three months. Using a semi-structured approach, I asked nine respondents 10 core questions each, beginning each interview with questions on general risks to Stanislaus County's agricultural and then moving to how climate change was related to the risks already discussed.

I interviewed four of the five county supervisors, both of the directing staff of Stanislaus County Farm Bureau, and four of the, at the time, six local scientists who serve as farm advisers through UC Cooperative Extension. All farm advisors interviewed had an educational level of a Master's degree or higher in a scientific field related to their work (e.g., plant or animal science). All county supervisors interviewed had a four-year college level education or higher and backgrounds, mostly professional and familial, in local agriculture.

RESULTS

My study assumes appropriate levels of climate risk perception in the study site would compel stakeholders to consider, at least in part, exacerbated agricultural risks within a context of climate change. According to my findings, this is not the case. Levels of anthropogenic climate risk perception remain low despite experiences of climate disruption. I found evidence for numerous social barriers within the study site. Different barriers affect different types of stakeholders, but some overlap.

The amount of cumulative farmland managed by respondents accounted for over 5000 acres, which is 0.07% percent of all farmland in the county. A comparison of crops grown by respondents to the 2016 agricultural census shows 35 of the 39 crop types fell into the category of Stanislaus County's top 10.

Table 1. Comparison of respondent crops to top 10 crops in Stanislaus County. The top 10 crops shown below are based on the 2016 Agricultural Census of Stanislaus County. Farmers tended to grow multiple crops. Other crops grown by respondents not shown below include carrots, potatoes, garlic and cherries (N=39).

Top agricultural products by production	Survey respondent crop distribution
1. Almonds	12
2. Milk	2
3. Chickens	0
4. Cattle & Calves	2
5. Nursery Fruit, Nut Trees & Vines	4
6. Walnuts	12
7. Silage	1
8. Turkeys	0
9. Peaches	1
10. Pollination, Almond	0

Barriers to adaptation

Below I discuss five barriers to adaptation within the study site. The list below is not exhaustive. Rather, it's linear: the barriers presented are associated with a specific stage of the adaptation process, as explained by Moser et al. (2010).

Table 2. Demonstrated barriers to climate adaptation

Primary barriers within Stanislaus County, CA
1. Risk denial 2. Opposing interests 3. Credibility and trust 4. Finite pool of worry 5. Existence of a threat signal

Barrier 1. Risk denial

Taken together, the responses I collected reveal that the majority of community member respondents were engaged in a culture of risk denial. One county supervisor's comment on climate change shows a nuanced view surrounding climate change that is able to be consistent with recent climatic changes by accepting naturally caused climate change while equivocating the science. The awareness of the connection between climate change and drought is prominent:

> I definitely think much of the science there is real and that we need to pay attention to it. I think it's a real question of how much of that is attributed to human behavior, as opposed to natural causes...I do think it's important that we do what we can to stem the tide of climate change, and the severity that it could cause in droughts...even if we do as much as we can, we will still not need our long term water needs without increasing our supply....we have to do more to recycle [our water]...while we're also addressing the impacts of climate change.

A farm bureau staff member used an analogy between the human life span and climate science, suggesting that 100 years is a long time in the context of climate science. However, climate science spans timeframes over hundreds of thousands of years. The same staff member doubted the certainty of existing

scientific evidence surrounding the issue after observing the seasonal drift that is linked to climate change and affecting crop production (Pathak et al. 2018):

> The question is, is there a change in the climate? I've been here fifty years, and yeah. I've seen it go up, I've seen it go down. I've seen it in all different kinds of positions...the problem is we're a microcosm in time and if you look back, we've had this before and probably had it much worse than we're probably going through now...Now how long will it hold? We don't know.

Barrier 2. Opposing interests

Farmers tended to support weaker environmental regulations, citing opposing economic interests and resources (i.e., water) needs. One example of the agricultural view of opposing interests is the example that one farm bureau staff member used: the state has "chosen an endangered fish over living, breathing humans." One county supervisor also spoke of the opposing water related interests of environmentalists and farmers:

> Environmental interests who do not want to see reservoirs increased, and some of them are extremists who believe in zero population growth and turning our communities into wildlife. I would say they are largely outside actors…[with] no familiarity with Stanislaus County. They're just trying to advance their agendas and impose them on our community.

The majority of my participants supported a repeal of cap and trade, but were unaware of grants offered through the program and available to them for water efficiency projects. Some respondents said or implied that they feel intentionally targeted by the state government, with some alleging the state government of trying to end the farming industry

Barrier 3: Credibility and trust

One of the most salient challenges to effective climate adaptation through local, regional and state partnerships will be the overwhelming lack of credibility and trust that local

stakeholders of Stanislaus County have in California's State government. The excerpt below from an interview with a local policymaker is one example of a common sense of mistrust.

> So I would argue that the state of California is doing everything in their power—and I appreciate this governor is his conservation efforts, generally—but I would argue that if we're going to have less snowpack, then we need to put in more storage facilities, because humans are going to get first check at the water, as they should. But if someone is saying there is going to be less water being able to be held, then somehow need to store that. It could be off stream, on stream, underground, it's all irrelevant to me, but as we try and meet all of these goals together, along with climate change, if it's happening, and it appears to me that it's happening, then we need more storage, but instead we're going away from storage.

The same county supervisor said, "I'm arguing that floating more water down the river indiscriminately...is just senseless with climate change, it would be actually detrimental. What is the end goal? That's my question to you." By asking what the "end goal" is, the respondent may have been alluding to a feeling of persecution echoed by another farm advisor, who said the state is trying to destroy California's agriculture industry.

Barrier 4: Finite pools of worry

Finite pool of worry is a description of an intuitive psychological limit: individuals cannot worry about infinite issues at once (Weber 2016). Individuals, groups and institutions must prioritize risks. According to risk theory, priority hierarchies depend on the perceived severity of a risk and its likelihood of occurrence. The Center for Research on Environmental Decisions discusses the finite pool of worry and cautions against the overuse of emotional appeals when communicating climate change issues so as not to attract from other valid and unrelated issues of concern (CRED).

One staff member to the farm bureau acknowledged seasonal drift in Stanislaus County and its effect on harvest times, but dismissed and human cause and said predicting the future is a challenge. Rather farmers are "focused on the here and now." High levels of concern for immediate water

resources like water may limit the capacity for risk planners to adequately and voluntarily consider the limited long-term resources challenges linked to climate change. Communicating impacts using as immediate timeframes as is scientifically possible may prove to be a beneficial counterbalance to the finite pool of worry effect.

Barrier 4: Existence of a threat signal

Some farm advisors in Stanislaus County do not discuss the threats climate change poses to California agriculture. The excerpt below captures one advisor's reluctance to engage with farmers on the issue in response to the question, "Are the risks of climate change discussed with farmers?" It has been edited for brevity and clarity.

> I think there are some farmers who are concerned. Some may or may not be, I don't know. We talk about changing weather scenarios. For example, the hot spell during the summer time and how that affects their day to day practices…Specifically, it may not be the whole climate change issue and global warming. To be honest, it's hard to pinpoint, and there might be some people who think it's happening and other people may not, so we don't want to go into that route in detail. But at the same time we can say, 'these are the things that seem like it's changing.' We can show the data—the past five, six years of data—and it seems like it's changing…so we talk about that, but it's mostly in datic ways.

This statement provided by one UCCE scientist is an example of attempts to communicate the reality of human caused climate change without naming the phenomenon specifically. When asked whether farmers were concerned about climate change, one farm advisor said, "Absolutely…[farmers] talk about global warming. You know, some people believe in it and some people don't." The same advisor continued: "Agriculture goes against all things environmentally. It doesn't mean to, it just does. We use a lot of tractors, burn a lot of fuel. Livestock, methane and all that stuff. Unfortunately, that's just how our food is made." Prior to specific questions on the topic, no UCCE scientist interviewed named climate change specifically when asked about general risks to Stanislaus County agriculture.

DISCUSSION

Individuals in in each social group tested (farmers, policymakers and advisors) discussed an established causal connection between climate change, environmental interests and regulations throughout the interviews, and either regulations in general or regulations relating to water were a risk factor for every respondent. The high levels of engagement with environmental issues is correlated with a lower likelihood of belief revision (Myers et al 2013). Belief consistent distortions occur when people who have experienced climate change do not revise their beliefs about whether or not the problem exists in what some researchers call a "rational manner;" Instead, individuals may distort reality to fit consistently with their existing belief systems (Weber 2016; Hart and Nishet 2011; Myers et al 2013).

The findings of this study paired with other research surrounding low social concern, its role, the "seeing-is-believing" effect, and the role that demographics and ideology play in blocking this effect through motivated reasoning processes should renew efforts for climate communication. In this discussion I will provide further examples of community narratives potentially of some insight to climate communicators. I will also identify trusted messengers in the community, which past studies have found to be of equal importance as communication methods, if not more so (Saleh Safi et al. 2012).

Identifying experts and building partnerships

Social scientists have provided society with knowledge and tools to be better climate communicators. Considering the first barrier, mistrust, it is possible that outside groups attempting climate communication will be quickly marginalized for speaking positively on the issue.. Recent analysis of three decades of media coverage shows that party elites are likely to be most responsible for partisan views on climate science, and suggests that if party elites who deny the scientific credibility of anthropogenic climate change changed their view, respective members of the public would follow (Merkley and Stecula 2018).

Research has found that individuals judge a scientists expert status based on whether or not a purported expert's conclusions about climate science match their conclusion, not on their educational credentials or job position (Kahan 2011). These findings raise the possibility of a

catch-22 for Stanislaus County farm advisors, because if they attempt to discuss climate change with farmers, they risk having their status as expert trusted information sources effectively revoked. As Saleh Safi et al. (2012) found, relationships between communicators and the community are just as important as using effective climate communication methods. However, given their knowledge disciplines, farm advisors have higher levels of climate science acceptance and may be more open to communicating the issue as compared to other trusted community messengers that farmers identified in survey responses (Figure 5).

Be them farm advisors or, importantly, another trusted messenger group, future communicators will need to consider different modes of framing a conversation about climate change. Common ones include (1) affect-based, (2) analysis-based and (3) rule-based (Weber 2016). The efficacy of affect-based and analysis-based communication frames are doubted by scientists, for the former the long term and gradual nature of climate change risks generally do not bring about visceral fear, and, for the latter future costs are often discounted,[10] which can result in lower risk perception levels than appropriate (Ibid). Weber's 2016 review of climate perception literature found rule-based modes reliant on moral principles or social responsibility to be the most promising communication method. Appealing to an individual's legacy motivation is a rule-based approach supported by recent research (Gott et al 1993). This method could be particularly salient to farmers and policymakers in Stanislaus County, as 90% of the farmers surveyed indicated their intentions to pass their farms onto to their children.

[10] **Discounting** is the conversion of a large future monetary value (e.g., expected cost of adaptation) into a small, even negligible, present value or vice versa. A **discount rate** is a numerical variable used during a discounting calculation. Small or large discount rates result in larger or smaller future cost estimates, respectively. New research suggest that climate change is nonlinear, suggesting that the use of small, linear discount rates may be inappropriate and lead to miscalculations of the real costs of adaptation. See Davidson 2014 for an argument in favor of using a discount rate of zero for estimates of the future costs of climate change and adaptation.

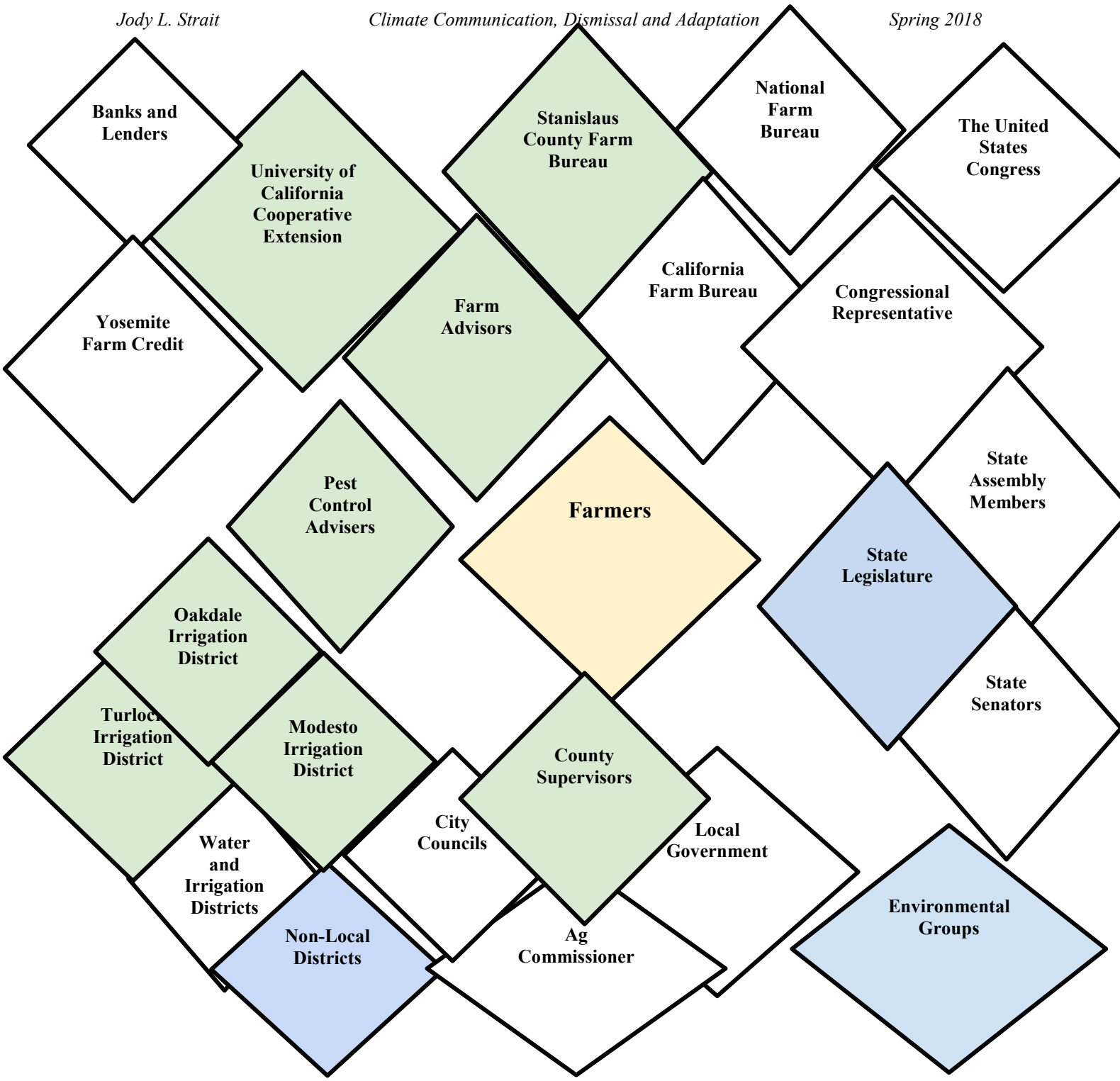

Figure 5. Clusters of influence: an emergent view of stakeholders in Stanislaus County agriculture. Green shading indicates trusted messengers to farmers, while blue indicates distrusted messengers from within and without the community. White indicators community members whose trust levels could not be sufficiently established.

Further community narratives

Stanislaus County was my home for 22 years. My decision to study environmental problems, such as climate change, transgressed the social norms of my hometown community. I often dreaded the question, "What do you study?" Responses I received, at times from complete strangers, were not usually conducive to friendly conversations: "Oh, you're one of those." At one point, a family member told me I should have gone to a "good school" instead of the University of California at Berkeley. The same family member said global warming was "a farce." A different family member invited me to work with him in the fossil fuel industry after obtaining my degree, and a former STEM[11] professor from my local community college told a fellow student and friend of mine that it was "too bad" I had "bought into the whole global warming myth." During a science colloquium presentation, I asked over 100 people if they knew or could think of a politically conservative person who believed in climate change. Not one of them did.

One of the most challenging experiences was not my own, but a friend's. He was a fellow STEM major, so I was surprised when he challenged the scientific consensus on climate change. I later learned his family also held this view. After several months and many long discussions, he changed his mind, but the fallout was emotionally wrenching. His family began to ask questions and express concerns. Climate change was one issue of several. He also challenged the evidence of human evolution, practiced a fundamentalist Christian religion and accepted ideological tenets of far-right US-American politics. My friend's reversal on one issue was accompanied by a shift on all the rest. Going against his culture resulted in serious consequences: intense alienation from the people with whom he was closest, both socially and financially. These experiences are examples of the myriad challenges arising from a cultural matrix rooted within a rural US American discourse that science communicators must navigate.

[11] STEM refers to the fields of science, technology, engineering and mathematics.

Limitations and future directions

The small sample size is the most significant limitation of my study. Because of the low farmer response rate, this study cannot be assumed to represent the majority opinion of Stanislaus County farmers. Furthermore, I was unable to examine the influence of political preference, political participation, gender and age on low climate risk perception in the study site. However, such analysis can be done in future studies. Party registration and voter frequency data is publicly accessible through the county recorder's office for a moderate fee. The names of farm owners, available through county permit and site data, could be matched with the names of party registrants and to reveal potential trends in party preference.

A similar analysis could also be done using voting records to gauge political participation. The political preferences and participation levels of farmers in Stanislaus County could then be interpreted using a large body of research showing how such factors predict climate change acceptance levels and risk perception, providing an understanding useful for policymakers and climate communicators (Weber 2016). Gender, which has been shown to be another determining factor—with females tending to have higher risk perception levels—could be analyzing with a reasonably small error margin using the names listed on permit and site data. Further analysis could also be done on the research proposals of UCANR farm advisors to check for trends in (1) proposed research relevance to anthropogenic climate change, (2) denial of funding from farm organizations, and (3) a potential correlation between (1) and (2).

Conclusion: the potential for deliberative communication methodologies

This study has been an attempt to better understand decision makers for risk planning frameworks in one agricultural community in California's Central Valley. I have shown that despite evidence surrounding the seeing-is-believing effect, respondents in my study site were embedded in cultures of risk denial in regards to anthropogenic climate change. Science communicators are wise to exert the caution that they do. They may benefit from trying evidence based communication methods when engaging with such communities. However, the discrediting of information deficit models from the field circa 1980 suggests that increasing a

community scientific understanding of the issue is not likely to lead to higher acceptance levels or concern levels, which influence support for adaptation and mitigation efforts.

Motivated audiences pose a catch-22 for climate communicators: they must earn and maintain community trust for effective communication to motivated audiences, but upon taking positions against community norms risk lose the community's trust. Perhaps applying the philosophical bottom-up approach of negotiators of the Paris Climate Agreement would benefit farm advisors and other communicators: research by Nerlich et al. (2009) documented positive results from supplementing traditional top down communication models with more deliberative, democratic, peer to peer methods that explore "novel, artistic or creative ways of communicating on these issues which differ from the more didactic approaches favored by official bodies." One example of this in the study site would be to increase the use of demonstration sites between farmers and farm advisors, which have been shown to increase conservation efforts (Singh et al. 2018) and were reportedly absent within in the study according to an UCCE farm advisor.

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