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Perceptions and responses to climate policy risks among California farmers

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ABSTRACT

This paper considers how farmers perceive and respond to climate change policy risks, and suggests that understanding these risk responses is as important as understanding responses to biophysical climate change impacts. Based on a survey of 162 farmers in California, we test three hypotheses regarding climate policy risk: (1) that perceived climate change risks will have a direct impact on farmer's responses to climate policy risks, (2) that previous climate change experiences will influence farmer's climate change perceptions and climate policy risk responses, and (3) that past experiences with environmental policies will more strongly affect a farmer's climate change beliefs, risks, and climate policy risk responses. Using a structural equation model we find support for all three hypotheses and furthermore show that farmers' negative past policy experiences do not make them less likely to respond to climate policy risks through participation in a government incentive program. We discuss how future research and climate policies can be structured to garner greater agricultural participation. This work highlights that understanding climate policy risk responses and other social, economic and policy perspectives is a vital component of understanding climate change beliefs, risks and behaviors and should be more thoroughly considered in future work.

1. Introduction

Global climate change will require socio-ecological systems to adapt across multiple geographic, time, and ecological scales (Adger et al., 2005). Research on agricultural systems has focused heavily on weather patterns, the frequency and intensity of extreme events (Rosenzweig et al., 2001), and time horizons that require a new set of adaptive behaviors (Jackson et al., 2011). Additional research has examined the potential economic impacts of climate change (Fischer et al., 2005; Tol, 2002) and the policy structures that may be needed to assist the agricultural community in adaptation (Howden et al., 2007; Smit and Skinner, 2002) and mitigation (Smith et al., 2007). This paper proposes that existing research has underemphasized a key feature of adaptation: how farmers perceive and respond to *climate policy risk*. The concept of policy risk is defined as a regulation or policy that may present economic, environmental or social risks to an individual or enterprise. In the context of agriculture, climate policy risk is the potential threat posed by climate change regulations or policies to mitigate or adapt to climate change.

We study climate policy risk in the local context of farmer attitudes and decision-making in Yolo County, California. Our global capacity for responding to climate change requires understanding how policies across multiple scales affect the local daily activities and perceptions of individuals (Ostrom, 2010) and how those local activities scale up to influence global outcomes (Wilbanks and Kates, 1999). In California, farmers are contending with the local development of county climate action plans (Haden et al., 2013) in conjunction with the state-wide cap and trade program AB-32 (California Air Resources Board, 2008), which though it does not include agriculture, does allow for a carbon offset market that may provide financial incentives for agricultural mitigation (California Air Resources Board, 2011; De Gryze et al., 2009). Nationally, policies require some large farms to report their greenhouse gas emissions (United States Environmental Protection Agency, 2009). California is not anomalous – farmers across the globe deal with multiple policy risks that influence their decisions and collectively scale up to affect the global food supply, environment, and agricultural markets in an increasingly global world (e.g. Cassells and Meister, 2001; Mihyo, 2003; van Meijl et al., 2006).

This concept of climate policy risk builds upon a growing body of work in energy policy and management to assess how investors and firms may respond to climate policy risks. Yang et al. (2008) examine how climate policy risks and uncertainty drives investors

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behavior in their choice of different energy generation options as a result of price changes. Related work shows how renewable energy investors respond to policy risks related to renewable energy policies, which affect their investment potential in a given region (Lüthi and Wüstenhagen, 2012; Nemet, 2010). Like these decision-makers in other sectors, changes in climate policy directly affect the overall risk portfolio faced by farmers in terms of the costs, benefits, and uncertainty around different decisions.

We extend the existing climate policy risk work into the realm of climate change adaptation and consideration for a farmer's adaptive capacity, vulnerability and resilience. The analysis builds on our previous work, which found that farmer adoption of adaptation and mitigation behaviors is influenced by their climate change attitudes and personal experience with climate change (Haden et al., 2012). Here we explore the relationship of climate change attitudes with policy experiences to expand beyond traditional measures of experience focused on biophysical indicators. Climate policies may affect the adaptive capacity of agricultural systems to respond to climate change if they require resources and costs that exacerbate vulnerabilities. We assess two dimensions of response: their concern for future climate policies and potential participation in a climate adaptation and mitigation incentive program, thereby measuring both a potential threat and opportunity. In the words of one farmer in Yolo County, California, "*We can adapt to the environmental aspects of climate change. I'm not sure we can adapt to the legislature*." Failure to consider climate policy risk responses overlooks key drivers of climate change attitudes and an opportunity for policymakers to gain policy support and participation on mitigation and adaptation initiatives (Falconer, 2000). Our results suggest that climate policy risks and non-climatic drivers should be more adequately considered when assessing climate change attitudes and behaviors.

2. Methods and place

Data were collected from interviews and a mail survey implemented in Yolo County in the Central Valley of California (Haden et al., 2012; Jackson et al., 2012). Yolo County is a predominantly agricultural region with more than 80% of the land in agriculture (California Department of Conservation, 2008). It was chosen for its diverse mix of cropping and livestock systems typical of the Central Valley, especially the Sacramento River region. The county is comprised of high-input, highly productive crop systems with a small (5% of total irrigated cropland) but growing organic sector, as well as grazed, non-irrigated grasslands and oak savannas (Yolo County Government, 2011). A case study describing the agricultural responses to climate change in the region can be found in Jackson et al. (2011). The rural and westernized context of our study site is worth noting as it may affect the overall policy and climate attitudes we found and may limit the generalizability of our results to other agro-ecological contexts. Understanding the diversity of policies and response to climate policy risks across regions is a key future research topic.

Interviews and consultation with a stakeholder advisory committee assisted in the development of a survey sent to 572 farmers (including ranchers) in 2011. Semi-structured qualitative interviews were conducted in 2010 with 11 farmers and two cooperative extension agents. Farmers' addresses were gathered from the County Agricultural Commissioner's Pesticide Use Reporting database, which reports all agricultural pesticide use (conventional and organic) (California Department of Pesticide Regulation, 2000), providing a viable list of most farmers in the county. Using the tailored-design method (Dillman, 2007), postcards were sent to farmers followed by a survey, a follow-up postcard, and an additional survey if necessary. Farmers with no response were contacted through telephone to provide reminders. In total, 162 surveys were analyzed resulting in a response rate of 33.2% when surveys outside the intended scope were withdrawn (American Association for Public Opinion Research, 2009). A copy of the survey is available upon request.

Table 1 reports the complete list of questions, variables, scales, and their descriptive statistics used in this analysis. Two dependent variables were used to measure responses to climate policy risks: *Regulation Concern* (i.e. a farmer's concern for climate change regulations and economic impacts) and *Government Program Participation* (i.e. willingness to participate in a climate change incentive program). Regulation Concern was determined with a factor analysis using principal component factors with varimax rotation, which indicated a single factor solution with factor loadings significantly greater than a cut-off of .40 (Costello and Osborne, 2005). We created a scale to combine questions measuring similar latent concepts to average responses (*Regulation Concern*, $\alpha = 0.72$) (Clark and Watson, 1995), which had a Cronbach's α coefficient higher than .70, a generally accepted cut-off point for reliability (Nunnally, 1978).

A number of independent variables were considered including *Climate Change Experience*, *Past Policy Experience*, *Climate Change Belief* and *Climate Change Risk*. *Past Policy Experience* was measured by assessing a farmer's overall perspective on four past environmental policies (Table 2). Farmers were asked to consider four questions for each policy as described in Table 1 (*Regulation Environment*, $\alpha = 0.69$, *Regulation Time*, $\alpha = 0.77$, *Regulation Cost*, $\alpha = 0.74$, *Regulation Balance*, $\alpha = 0.73$). A factor analysis was also conducted as described above, which determined that each of the four questions grouped together across environmental policies. In other words, farmers tended to have the same general opinions about whether environmental policies were effective, expensive, time consuming, or balanced in their approach. Each question formed its own scale (i.e. *Regulation Environment*, *Regulation Time*, *Regulation Cost*, *Regulation Balance*) that together formed the observed variables related to the latent variable *Past Policy Experience*. Other independent variables included *Climate Change Experience* measured using a farmer's perceived change in water availability over time in Yolo County and *Climate Change Belief* and *Climate Change Risk* as latent variables compiled through several questions indicated in Table 1.

We constructed a structural equation model (SEM) using maximum likelihood estimation. The model was continually refined by removing non-significant pathways in a step-wise order. Only significant coefficients and models are reported in this paper. Statistically significant measures for farmer and farm characteristics (education level, full-time farmer status, organic status, local Yolo County origin) were included in the final model, which are shown in detail in the supplementary materials. Our previous work found that farmer experiences with temperature change did not influence their climate change belief or risk perceptions or their willingness to adopt behaviors for climate change adaptation and mitigation. This is likely because of a general perception that Yolo County has not seen significant changes in temperature, providing minimal variance in farmer responses. Based on this we excluded temperature change perceptions from our structural equation model in this analysis. Additional research in other regions where temperature-related impacts may be more apparent or perceived to be more common may find that temperature-related perceptions are an important predictor for climate change belief and risk perceptions, policy attitudes and the adoption of practices for climate change mitigation and adaptation.

The results of our SEM should be considered in the context of our population – a rural region made up of a small group of farmers. While some researchers may argue the sample is too small for robust estimation of SEM models (MacCallum and Austin,