

## **ABSTRACT**

BULLA, BRIAN REID. Exploring Vulnerability to Climate Change: Lessons Learned through Multiple Methodologies and Local Knowledge. (Under the direction of Dr. Toddi A. Steelman.)

A majority of the climate change literature suggests the issue is best understood in scientific and technical terms, meaning that only experts with appropriate technical knowledge are suitably informed to understand the data and determine appropriate responses. Academics and experts who characterize climate change as a problem largely impacting roads, infrastructure, the economy, and other inanimate objects reify climate change as a technical problem. This reification can marginalize the vulnerabilities of people, livelihoods, and communities.

Therefore, finding new pathways that expand our understanding of social vulnerability in the context of climate change is critical to improving policies and research practices. To do so requires using an extended community of knowledge beyond that of the technical experts. The additional knowledge would include concerned citizens with vested interests that might otherwise go un-discussed. By including participants external to the scientific community, a more well-rounded and inclusive discussion of climate change could be had, and decisions regarding what to address and how to address it would be created thereby addressing social vulnerability.

This dissertation is comprised of three case studies that use multiple methodologies to explore elements of vulnerability to climate change. The first study used an online survey to quantitatively explore whether personal knowledge about climate change, political ideology, or a perceived threat from climate change affected

the willingness of North Carolina coastal officials to take adaptive action. The study also investigated what official's feel are the top threats from climate change to their communities. The second study utilized photovoice to qualitatively explore how small family farmers in Chatham County, NC are experiencing climate change. The third study used a rapid assessment and the Trinity of Voice (ToV) model of public participation to explore participatory processes from the point of view of water committee members in Hamakuya, South Africa to better understand water resource management practices in the context of climate change.

Results from the first study indicated that coastal officials were willing to take adaptive action based on a perceived threat from climate change, more so than solely based on their personal knowledge about climate change or their political ideology. Potential flooding, erosion, and sea level rise were frequently cited concerns of coastal officials. Findings from the second study suggested that small family farmers in Chatham County were experiencing changes in precipitation patterns, detecting invasive species, and implementing adaptive behaviors such as agrivoltism and polyculture to bolster the resilience of their farms and strengthen their connections with the local community. Findings from the third study signaled a well-functioning and deferential system of traditional governance. Additional analysis indicated that headmen played an integral role in water resource management by acting as intermediaries between chiefs, water committees, and villagers. Although findings specific to the elements of access, standing, and influence associated with (ToV) suggested uncertainty about the functional authority of water committees, data revealed mutual respect and standing between villagers and water committee

members, and an ability of villagers to influence local rules in the participatory process.

Expanding our examination of climate change beyond technical assessments can yield important insights. Findings from the first study question whether coastal officials are exercising leadership in allowing for adequate time to prepare for the expected impacts from climate change or fully understand the risks. The second study illustrated how these farmers are fostering the long-term viability of the livelihood that they see as a creative act through the careful stewardship of the local ecosystem. From the third study we learned that expanding the (ToV) model to include an element of deference could increase its relevance to more accurately reflect the social and cultural norms in Hamakuya.

**Exploring Vulnerability to Climate Change: Lessons Learned through  
Multiple Methodologies and Local Knowledge**

by  
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## **DEDICATION**

This dissertation is dedicated to my brother, Bobby, and his family; wife, Robin, and two sons, T.J., and Chase. I have tremendous love and respect for my brother, and am awed by his capacity and passionate commitment for service to others that he demonstrated through his professional career and continues to demonstrate in his personal life. To Robin, Bobby's wife, you are a wonderful sister to me, and you have my respect and gratitude for having the strength and fortitude to corral those three boys. To T.J., Bobby and Robin's eldest son, for demonstrating leadership, maturity, composure, and service beyond your years. Lastly, and perhaps most importantly, to Chase "Dodo" Bulla, Bobby and Robin's youngest son, who tragically passed away four months prior to my dissertation defense. Chase was a kindhearted, compassionate, smart, and strong young man with a ruggedly independent mind who was lost to his family and friends entirely too soon on January 7, 2015.

## **BIOGRAPHY**

Brian Bulla earned Ph.D. in the Department of Forestry and Environmental Resources at North Carolina State University. Prior to beginning his PhD studies, he completed a Master of Public Administration and a Master in International Studies at NCSU. As a policy scientist, Brian is interested in how people problematize and research vulnerability to climate change. Brian is originally from Greensboro, NC; he and his family currently reside in Lenoir, NC.

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## **ORIENTING VULNERABILITY TO CLIMATE CHANGE THROUGH THE POLICY SCIENCES**

A substantial portion of the policies and research into vulnerability to climate change seems to overwhelmingly favor a technical, impact-related orientation (Ionescu, Klein, Hinkel, Kumar & Klein, 2009; O'Brien, Eriksen, Nygaard & Schjolden, 2007; Eakin & Luers, 2006; Luers, Lobell, Sklar, Addams & Matson, 2003). Vulnerability to and from climate change is much more than damage to buildings or sectors of the economy as portrayed in the majority of the literature (Brooks, Adger, & Kelly, 2005). Understanding and addressing personal and social vulnerabilities such as: diminished health outcomes (through an increase in morbidity and mortality, stress or depression, vector borne illness, malnutrition or contamination); deprivation of a preferred livelihood; loss of social or communal connections; damage to or destruction of culturally important landmarks or practices will all require a more culturally sensitive orientation to the problem of climate change. If policy-makers and researchers are not mindful, and without an approach that includes cultural orientation of the problem, climate change vulnerability is in danger of becoming reified primarily as an impact to infrastructure and sectors of the economy. Furthermore, if vulnerability to climate change continues to be understood through computer modeling, scenario building exercises and the institutions supporting these probabilistic practices, then policy responses designed to address social vulnerability may become marginalized.

## **Introduction**

Pick up nearly any peer-reviewed journal reporting research about climate change and you are almost certain to find near complete consensus among scientists that anthropogenic climate change is occurring (IPCC, 2014; Anderegg, Prall, Harold, & Schneider, 2010). If unanimity within the scientific community is not enough to influence policy makers to take adaptive action to address climate change, then perhaps mounting public awareness and pressure emanating from focusing events (Birkland, 2005) like flooding from Hurricane Irene in 2011, dramatic changes in precipitation and temperature patterns, devastating wildfires, or heat-related illnesses might begin to sway officials to take comprehensive adaptive actions.

Critically important and embedded within the changing climate and resulting impacts are the vulnerabilities of people and their livelihoods. Unlike assessing the damage to buildings, roads or the operational capacity of economic sectors such as energy, unraveling the vulnerability of people and livelihoods is more imprecise with no clearly defined estimates like those found in a cost benefit analysis. Yet investigating the multitude of ways that people are vulnerable to climate change has important environmental justice implications (Adger, Paavola, Huq & Mace, 2006).

This dissertation encompasses three case studies, each situated in the context of climate change and each takes a different methodological approach thereby creating a portfolio of integrative research. The first case study utilized an online survey to explore the willingness of NC coastal officials to take adaptive action to climate change. The second case study used photovoice, a community-based participatory research method, to examine how small family farmers in central

North Carolina (NC) are farming through a changing climate. The third case study used rapid assessment to examine participatory processes in rural South Africa regarding water resource management.

Finding new pathways that expand our understanding of social vulnerability in the context of climate change is critical to improving government policies and clarifying research practices. I suggest there is a relationship between a researchers' rationale and their conceptualization of vulnerability that influences their methodological orientation for exploring vulnerability to climate change. This insight, and its implication for research, will be clarified throughout the chapter.

Finding those new pathways to address grand challenges like climate change requires thinking about how we think. In 2010, Lakoff cautioned researchers that when communicating with public audiences it is important to be aware of how we frame our understanding of environmental issues. By extension, I suggest it is also important how we think of, discuss, and frame vulnerability to climate change. Complex issues like the environment and vulnerability require a complex and integrated understanding because “the environment is not just about the environment. It is intimately tied up with other issue areas” (Lakoff, 2010 p76). Without an appropriately rigorous frame of understanding, we fail to properly situate a complex issue resulting in the inability to “capture the reality of the situation” (Lakoff, 2010 p76). Lakoff (2010) terms this failure hypocognition or “the lack of ideas we need” (p76). This hypocognition operates just below the policy-surface related to climate change by creating gaps in our collective understanding and limiting our grasp of vulnerability to climate change. This deficiency of thought matters significantly in terms of addressing social vulnerability.

Navigating the analytical turn required to address this hypocognition calls for a sufficiently powerful heuristic. The Policy Sciences framework is both a practical theory and flexible heuristic for policy practitioners. In 1971, Harold D. Lasswell, one of the seminal figures in the development of the policy sciences, stated “that the policy sciences are concerned with knowledge *of* and *in* the decision processes of the public and civic order” (p1) (italics in the original). Lasswell (1971) went on to state one of the significant strengths of the policy sciences approach is in distinguishing the functionally important issues and attributes from what might otherwise just be customarily included considerations thereby avoiding the often “fragmented worm’s eye view of policy matters” (pxiii). Thus, the policy sciences are one way to assist in taking a more comprehensive look at vulnerability to climate change, especially as it relates to the vulnerability of people and their livelihoods.

Beyond the technical considerations traditionally incorporated into most policy discussions this comprehensive and flexible framework is intentionally structured to integrate institutional, social and political factors in “an effort to systematize the major variables with which social scientists grapple in all political and policy inquiry” (Clark, 2002 p10). Each of the three dimensions (social process, decision process and problem orientation) of this heuristic have been used by a variety of researchers to contextualize their understanding of different natural resource and policy issues.

For instance, Clark and Wallace (2002) used one dimension, social process, to highlight missteps in two cases concerning recovery programs regarding endangered species. Mapping the social process may uncover important internal expectations and external value demands of participants and “reveal trends and why trends are

taking place that may not be evident otherwise” (Clark & Wallace, 2002 p91). Steelman and Kunkel (2004) used another dimension, decision process, to examine divergences in the social and structural responses of two communities to wildfires in New Mexico. The decision process of the policy sciences framework is a heuristic or “theory of process that facilitates understanding a given decision, rather than a theory of prediction about what will happen with a decision” (Steelman & Kunkel, 2004 p681). Here again, a dimension of the policy sciences is used to gain critical and traditionally untapped insight into policy decision making. Furthermore, Barrett (2013) used the third dimension, problem orientation, to argue that alternative sources of knowledge should be included along with traditional Western knowledge in an effort to improve socio-ecological decision-making. In this research the heuristic was instrumental in pointing out the conditioning factors and relevant trends along with “understanding some of the challenges and opportunities related to the inclusion of transnational knowing in socio-ecological decision-making” (Barrett, 2013 p187). Each of these studies showcases the analytic power of the framework.

The policy sciences are thoroughly comprehensive and appropriate for the analytical task of researching social vulnerability to climate change. For instance, social process could be used as an analytic framework allowing researchers to address vulnerability to climate change in a more holistic manner, thereby enlarging the policy discussions and responses addressing social vulnerability in a way that enhances human dignity for all participants.

Later in the chapter I identify the research methods I used in applying the policy sciences framework. Throughout the chapter I point out the significance of

examining the underlying suppositions involving research into vulnerability to climate change. However, in the next section I set the stage for understanding the three dominant research perspectives driving vulnerability assessments by discussing how they are shaped by two very different rationales-- *a technical rationality and a cultural rationality*. It is important to recognize that these rationales inform how we as researchers come to identify and comprehend vulnerability. From that recognition research is conducted, data and information shared, conclusions are drawn and policies are designed which have social consequences.

### **Researcher Rationality - Two Dominant Viewpoints**

A primary point of intervention in addressing social vulnerability revolves around knowledge and whether or not researchers value various forms of knowledge. The decision about whose knowledge and what types of knowledge are incorporated into vulnerability research and policy discussions becomes a crucial consideration because both the knowledge included and excluded jointly construct the formulation of the problem and how it is addressed. Plough and Krimsky (1987) note how two dominant viewpoints, technical rationality and cultural rationality, often mediate the construction of policy discussions especially those involving risk communication; which is especially relevant for climate change.

A strictly empirical approach to conducting research relies heavily on the scientific method and “expert judgments in making policy decisions. Emphasizing logical consistency and universality of findings, it focuses attention in public decision making on quantifiable impacts” (Fischer, 2000 p132). Participants with this

viewpoint might, by design, value certain types of information and sources of knowledge from ‘experts’ while downplaying the contribution of those participants not in the scientific community. In terms of communicating risk, Plough and Krimsky (1987) state how under a conventional or technical rationale “some researchers view the exchange of risk information as flowing from technical elites to the polity as a form of scientific noblesse oblige” (p7). This technical framing of issues necessarily dictates that there are appropriately informed experts and others. The expert is someone who knows the sources and types of information needed to address the issue with the proper intention (Plough & Krimsky, 1987). A researcher operating under technical rationality assumptions would resist the inclusion of non-experts, or those not properly qualified in the process and see “the involvement of more people as merely clogging up the process” (Fischer, 2000 p142).

Cultural rationality is more inclusionary in that it represents a “different way of thinking about risks, one related more to a cultural logic” (Fischer, 2000 p123). A research perspective grounded in cultural rationality would approach vulnerability quite differently by valuing social groups, peer information and knowledge alternative to the “depersonalized technical calculations” of technical rationality (Fischer, 2000 p132). Further illustrating the differences between these two rationalities, Fischer (2000) notes how cultural rationality would be concerned with the “standing or place of the individual in his or her community, and the social values of the community as a whole” (p133).

Ultimately these two rationales pivot on the importance of different types of knowledge and whether context matters. Where cultural rationality emphasizes a need to investigate behavioral, anthropological and phenomenological issues

“technical rationality, on the other hand, believes that risk can be studied independently of context” (Plough & Krimsky, 1987 p8). Plough and Krimsky (1987) suggest that cultural rationality sees value in incorporating scientific rationality though the inverse is not true. “Cultural reason does not deny the role of technical reason; it simply extends it” (Plough & Krimsky, 1987 p8).

There are many long term societal consequences in taking a technical rationality approach to understanding vulnerability. For instance, using solely a rational-technical approach inhibits the ability of officials from gaining a dynamic understanding of vulnerability as a social construct (Adger and Kelly, 1999) has the potential of alienating people from participating in the governing process because they feel that their perspectives are not being valued (Toker, 2004); and in doing so creates a path dependent process that necessarily excludes broader considerations of vulnerability. Subsequently the consequences from each of the rationales enable certain values to flourish while neglecting other values. In practice technical rationality lends itself to values of power and wealth where authority and expertise are prized and when there is “controversy in science, resolution follows status” (Plough & Krimsky 1987 p9). Ascher, Steelman, & Healy (2010) see similar issues with how some forms of knowledge are more privileged than others noting “A far-reaching side effect of the deference accorded to formal science is that policymakers inherently privilege quantitative data over qualitative information in how problems are defined and addressed” (p85). This deference or bias could marginalize local or contextualized sources of knowledge, thereby limiting potentially relevant information. However, cultural rationality fosters other values including well-being,

respect and rectitude whereby emphasis is placed on family and community, and is “less concerned about consistency of approach” (Plough & Krimsky, 1987 p9).

When a researcher adopts a technical rationality or cultural rationality standpoint they are creating an epistemology that shapes how they come to understand and approach the study of vulnerability to climate change. Presumably, in practice researchers might adopt some hybrid of the two rationalities, but for the sake of this discussion it seems helpful to present the rationales as dichotomous to illustrate their potential influence. Being cognizant of that selection and its implications are important factors to consider and central considerations of my research.

The next section will briefly discuss the importance of research participants in the process. The following section will begin unpacking the three dominant perspectives surrounding vulnerability to climate change and how the technical and cultural rationales mentioned above fit with each.

## **Situating Researchers as Participants**

Does vulnerability mean susceptibility to a risk, poor access to food, having few economic opportunities, limited political participation, social or religious marginalization, imminent or future danger to your home or livelihood, threats to public infrastructure, or something completely different? Given the inherent difficulties in delimiting the concept of vulnerability (Ford & Smit, 2004), various researchers have labored to generate meaningful, policy-relevant and evidence-based conceptualizations of vulnerability. Social process analysis (Clark, 2002; Lasswell, 1971) can facilitate disentangling how we understand vulnerability.

Central to social process are participants and their perspectives (Clark, 2002). Accounting for the inclusion and exclusion of particular individuals, groups or organizations that are allowed to participate in a policy process can create lasting solutions that are embraced by a community and participants or foster resentment and the perceived deprivation of values held by the participants (Clark, 2002). The values and perspectives of researchers shape their actions and findings, so an inclusive analytic environment can potentially lead to more sustainable solutions. As simple and sensible as this sounds, it does not occur all of the time. By applying elements of social process it becomes evident how participants with a particular orientation towards vulnerability would pursue different strategies through the use of their base values, which would ideally bolster both their short term outcomes and their longer range value preferences for the future (Clark, 2002; Lasswell, 1971). This will be a recurring theme throughout this chapter and my three case studies.

The next section explores three dominant conceptualizations of vulnerability in the literature, but for now it is important to understand that the rationales are linked to the community of university researcher-participants which are linked to the conceptualization of vulnerability. Understanding the community of university researchers as participant is critical because studies conducted under a particular conceptualization of vulnerability (technical or cultural rationality) leads to particular outcomes with linked effects.

## **Vulnerability – Three Conceptualizations**

There is a measure of consensus across the field of vulnerability research. Researchers agree that defining vulnerability usually involves using the following

terms: *exposure*, *sensitivity* and *adaptive capacity* (Death, 2014; Adger et al., 2006; Eakin & Luers, 2006) but beyond that point researcher perspectives diverge. Though there might be some variation in the precise measurement of *exposure*, *sensitivity* and *adaptive capacity* researchers in much of the climate change and natural disaster management literature generally make the ontological commitment that vulnerability encompasses some combination of these three elements.

Given the array of climate change-vulnerability research projects being conducted by a variety of researchers from very different disciplines it is easy to see how vastly divergent research perspectives emerge. It is important to understand that at its core, vulnerability is a construct (Death, 2014; Ionescu et al., 2009; Eakin & Luers, 2006; Adger & Kelly, 1999) where measurement and quantification are at best approximations. Vulnerability is therefore understood in a number of different ways that can lead to ambiguity and confusion within policy and research. Because there are multiple interpretations of vulnerability policy makers, researchers and non-governmental organizations (NGOs) must rely on proxies to gauge vulnerability (Luers, 2005; Luers et al., 2003; Adger, 1999).

Understanding how vulnerability is framed, or the ontological perspective of the researcher and policy community matters, to the eventual formulation of research studies and policy prescriptions. Embedded within climate change are conditioning factors (economic, political, social, environmental, cultural, etc.), which influence the ability of people to adapt to a changing environment. Inherent within the disciplinary studies of vulnerability to climate change is a deeper story and an unfolding history of how the lives and livelihoods of people and communities are being fundamentally altered.

Eakin and Luers (2006) note three primary conceptualizations of vulnerability within the contemporary literature: vulnerability as understood from a risk-hazard perspective, a political economy perspective, or a perspective focused on resilience. Within these conceptualizations some researchers choose to frame vulnerability as an outcome, or end point, resulting from external events thereby constituting a risk-hazard outlook. Others frame vulnerability as a starting point which necessarily predisposes certain groups or populations to significantly more harm than other populations in line with a political economy point of view. Still others work towards an integrated ecosystems approach, which looks at the interaction of human and environmental systems, taking on a resilience perspective. Given the ambiguity and multitude of ways of categorization vulnerability it becomes even more important to heed Clark's (2002) call to carefully examine the social process of a policy issue.

### ***Risk-hazard***

Technical rationality informs a risk-hazard conceptualization of vulnerability and focuses the attention of researchers on specific aspects of the problem to the exclusion of other aspects. This conceptualization of vulnerability prioritizes research efforts that value authority, expertise, and power including the power to define, categorize, and evaluate risks.

This framework presents vulnerability as an *outcome* or end point of a materialized risk. In this context vulnerability involves a *hazard*, an *exposed sector* and an *impact*. “Vulnerability here summarizes the net impact of the climate problem, and can be represented quantitatively as a monetary cost or as a change in

yield or flow, human mortality, ecosystem damage, or qualitatively as a description of relative or comparative change” (O’Brien et al., 2007 p75). In addition to being a popularly used framework in climate science, the risk-hazard framework is also used in the disaster management literature where vulnerability is seen as a “dose-response relationship between an exogenous hazard to a system and its adverse effects” (Fussel & Klein, 2006 p305). Here, elements of sensitivity are used as metrics of vulnerability. This framework takes a rationalist approach to understanding vulnerability where it is not uncommon to see influences of cost-benefit analysis and complex mathematical computations to convey vulnerability (IPCC, 2012; Wisner, Blaikie, Cannon & Davis, 2010; Ionescu et al., 2009). At its most basic level the risk-hazard framework understands vulnerability from a technical orientation as an explicit and clear-cut relationship where the potential negative effects and outcomes from a stressor “serve as a rough equivalent to vulnerability” (Eakin & Luers, 2006 p369).

Changes in temperature patterns will be one of many effects of climate change and perhaps one of the most studied areas because “the links between changes in temperature and climate change are more direct and well documented than other climate-linked hazards such as flooding/precipitation” (Romero-Lankao, Qin & Dickinson, 2011, p3). As such, Romero-Lankao’s et al. (2011) meta-analysis of (urban) vulnerability to temperature-related hazards notes “the dominance of a single research paradigm, *urban vulnerability as impact*, which focuses primarily on the hazards and tends to underemphasize or take a limited view of social and/or structural determinants of vulnerability” (p2). This impact/end-point paradigm shaping much of the research and policy regarding vulnerability

tends to ignore other equally fundamental dimensions and determinants; to produce a set of explanatory variables that are tightly constrained by the availability of data, ... and omits any attempt to gain ethnographic knowledge of behavioral norms, social networks and risk perceptions that are equally relevant to understanding (urban) vulnerability (Romero-Lankao et al., 2011 p8)

Researchers adopting a risk-hazard orientation to vulnerability have perspectives focused on impacts to sectors of the economy and infrastructure where other participants focus on livelihoods or conditioning factors leading to vulnerable situations. Government officials and agencies routinely have access to sizeable budgets and professional discretion to facilitate studies, generate analysis and write subsequent plans that foster their official mission and in some cases their multiple and not always consistent agendas. So it is no coincidence that governments and other regulatory institutions initiate and otherwise direct the bulk of analytic attention regarding vulnerability to climate change on sectors, cities and states. Seldom, though, have the reports or plans looked beyond their own jurisdictional boundaries to incorporate regional influences or impacts; this is a weakness present in many studies regarding vulnerability and climate change. This focus on sectors as one of the two dominant units of analysis in the vulnerability and climate change literature is documented in countless research papers and government reports concerning fisheries and marine policy (Hoving, Lee, Badra & Klatt, 2013; National Fish, Wildlife and Plants Climate Adaptation Partnership, 2012; Grafton, 2010); transportation and infrastructure (U.S. General Services Administration, 2013; Center for Clean Air Policy, 2012; Hodges, 2011); water, drought and flooding (Konikow, 2013; Sorrensen, 2006); agriculture (U.S. Department of Agriculture

Technical Bulletin no.1935, 2012; Tol, Fankhauser & Smith, 1998) and forestry (Gunn, Hagan & Whitman, 2009) to name just a few topics.

Analysis based on a particular sector can serve as a common sense starting point to understanding vulnerability to climate change. Through industry-specific analysis, the sector approach can provide researchers and decision makers with a certain depth of knowledge and sense of certainty they may seek in what is otherwise an uncertain policy domain. An advantage of this type of analysis lies in tapping the specialized and institutional knowledge of trained professionals who, for instance, might have worked as a transportation engineer and understands the intricacies regarding temperature and moisture tolerances of different building materials, design limits of various structures or the stress points systems. However, this tranche examination of sectors might also necessarily limit their breadth of analysis, potentially hinder future planning or policy options, or perhaps generate questions about the validity of their conclusions as an autopoietic system in line with Luhmann's functional systems theory (Baxter, 2013), if other important or functional influences are overlooked (Lasswell, 1971). Ultimately, such a self-referential system could prove to be a critical limitation and have significant implications for people and communities, if this sector-based approach remains the dominant unit of analysis for many researchers and policy makers. For instance, an overly narrow focus on protecting the transportation sector could negatively impact less civically engaged communities.

Further evidence of a tendency to formulate policy strategy and response based on a risk- hazard orientation can be seen in the efforts of many states and a few larger municipalities who are focusing in on climate change. Such studies and

initiatives into vulnerability and climate change are primarily expressed through official climate change mitigation or adaptation plans, if those governing bodies take the additional steps to draft plans. Where such plans do exist they are often replete with sector-based analysis that leans heavily on a risk-hazard orientation to vulnerability. For example, Michigan (Chester, 2009), Iowa (Schnoor, 2008), Arkansas (Webb and Smith, 2008), Connecticut (McCarthy, 2005), Hawaii (Alber, Tantlinger and Kaya, 1998), Maryland (Maryland Department of the Environment, 2010), Seattle (Hayes & Koo, 2012) and Madison, Wisconsin (Somers, 2002) all have some combination of separate sector-based analysis for Residential, Commercial and Industrial; Energy; Agriculture; Forestry, and Waste Management; Transportation and Land Use issues. These plans tend to see vulnerability as a result of negative impacts to infrastructure investments, so they place considerable emphasis on protecting those capital investments within their jurisdictional authority.

Working through social process, we understand why governments pursue sector-based strategies because they are concerned about protecting capital investments (wealth) in infrastructure that can lead to focusing on one sector (transportation) to the exclusion of others (public health, alternative energy, storm water, etc.). In an effort to achieve the long range effects they prefer (i.e. limiting damage to infrastructure or securing future operations) officials strategically prioritize the use of their base values or financial assets. Another related aspect of the institutionalized context involves administrative compartmentalization, narrow budget authority, constricted understandings of agencies' domains of authority more generally, and restrictions on agencies' scope of work. It becomes relatively easy to see the outline of technical rationality in this orientation towards vulnerability.

Importantly, social process provides a calculus allowing analysts to clearly see how policy issues are in many ways battles over values.

### ***Political economy***

Cultural rationality informs a political economy conceptualization of vulnerability, and similar to other conceptualizations, focuses the attention of researchers on specific aspects of the problem to the exclusion of other aspects. This conceptualization of vulnerability prioritizes research efforts that value well-being, respect, and rectitude of individuals and communities through a process of discursive negotiation. This conceptualization is important because vulnerability is no longer understood as a negative outcome or end point from an isolated event but instead begins to be understood as a starting point created by a constellation of factors (Eakin & Luers, 2006).

Social process serves as a powerful heuristic under the political economy orientation to improve the collective understanding of vulnerability to climate change. Features inherent within the pillar of political economy include modifying forces over the control of resources and production of goods and services; constraints on relations between members of society whether between classes, families, or employers; and still larger institutional forces such as “issues of law and order and how these are exercised” (Wisner et al., 2010 p94). This focus on institutional forces that are simultaneously subtle and coercive is much different from the straight-forward calculation of the risk-hazard orientation towards climate events, sectoral risks and damage outcomes.

Researchers operating under this second framework take significant steps toward including social systems along with natural systems into consideration when framing vulnerability. The political economy framework presents a contextualized understanding of vulnerability where a variety of political, social, economic, institutional, and biophysical forces combine to create a vulnerable starting point (Wisner et al., 2010; O'Brien et al., 2007; Adger et al., 2006; Eakin & Luers, 2006; Fussel & Klein, 2006; Kelly & Adger, 2000; Adger, 1999; Adger & Kelly, 1999). By applying social process here it becomes evident how researchers emphasizing a political economy orientation towards vulnerability use different strategies to highlight different concerns.

Participants framing vulnerability under this orientation see vulnerability as “a characteristic of social and ecological systems that is generated by multiple factors and processes” (O'Brien et al., 2007 p75) including poverty, inequality and institutional adaptation (Adger & Kelly, 1999). Here, powerful and influential social factors become key determinants of vulnerability. “Poverty, the use of resources, and the distribution of assets and income within a population are all institutionally determined, and hence central to a political economy analysis of vulnerability” (Adger, 1999 p256). Research into social vulnerability at the district-level in coastal Vietnam (Kelly & Adger, 2000; Adger, 1999; Adger & Kelly, 1999) illustrates how the vulnerability of a coastal community in northern Vietnam with strong ties to the political elite of the area is experienced differently across various populations depending on their ties to the political network. Because vulnerability under this conceptualization is in large measure socially created and maintained, participants espousing a political economy perspective may not necessarily have the considerable

financial or physical resources of the participants in a risk-hazard orientation, much less the power to leverage economic strategies. When vulnerability is framed through a political economy conceptualization, researchers factor different strategies, situations and outcomes into their analysis. As mentioned above, when researchers consider impacts to livelihoods along with local or cultural insights into their analysis a deeper understanding of the contributing factors to vulnerability is gained.

By including human and social elements into the calculation of vulnerability, researchers and policy makers begin to capture some of the non-market values in nature and in their community that a strict risk-hazard framework would fail to include in its focus on impact assessments (O'Brien et al., 2007). Vulnerability viewed through a political economy lens is seen as a condition "moderated by existing inequities in resource distribution and access, the control individuals can exert over choices and opportunities, and historical patterns of social domination and marginalization" (Eakin & Luers, 2006, p370).

The political economy framing of vulnerability and vulnerability assessments unfold through various iterations beyond the primary framework presented above. For instance, the pressure and release framework (PAR) is a two-step conceptual model of vulnerability where processes causing vulnerability (root causes, dynamic pressures and unsafe conditions) interact with a natural hazard (earthquake, drought, flood, etc.) creating pressure that causes a disaster (Wisner et al., 2010). The acronym PAR used here does not represent, nor should it be confused with, the methodological approach to social science known as Participatory Action Research. The PAR framework used here views vulnerability as a dynamic starting point, and focuses attention on impacts to individuals and households at a local level which is

unlike the risk-hazard framework. The risk-hazard framework focuses on impacts to specific sectors and infrastructure, views vulnerability as a natural, inevitable and evolutionary (NIE) occurrence, and tends to focus on a larger scale than the PAR framework. The same collection of researchers unpacks the static nature of the PAR model a bit more to reveal another model, the access model. The access model focuses on “the process by which the natural event impacts upon people and their responses. It is a much more magnified analysis of how vulnerability is initially generated by economic, social and political processes, and what then happens as a disaster unfolds” (Wisner et al., 2010 p50).

This section has shown how the political economy conceptualization of vulnerability is different from the risk-hazard viewpoint by focusing on conditioning factors that enable vulnerability. The next section will discuss the resilience framework, which is also different from the other two because it focuses on dynamic systems and the capacity of eco-regions to respond over a longer temporal dimension.

### ***Resilience***

A synthesis of cultural and technical rationality informs the resilience conceptualization of vulnerability and focuses the attention of researchers on specific aspects of the problem to the exclusion of other aspects. This conceptualization of vulnerability prioritizes research efforts that value knowledge about larger ecosystem processes while also being mindful of balancing human well-being and ecosystem dynamics when exercising power to make decisions affecting a much larger community over a longer temporal dimension. This framework continues the process

of integrating human and social attributes with biophysical elements and events into the vulnerability calculus.

Researchers operating within this resilience paradigm suggest vulnerability is “a dynamic property of a system in which humans are constantly interacting with the biophysical environment” (Eakin & Luers, 2006 p371). Fussel and Klein (2006) note the causal interplay of biophysical and social elements in determining vulnerability. O’Brien et al., (2007) examine the framing of global environmental change to discover how different interpretations of vulnerability are presented, and how each of the different representations of vulnerability frames the issue of climate change differently. The resilience framework stresses adaptive management and resilience among systems and societies while situating the natural environment as acting in concert with human activities (O’Brien et al., 2007). In contrast to the risk-hazard framework which sees the natural system acting upon human settlements causing negative impacts, and the anthropogenic causes of vulnerability (Eakin & Luers, 2006) from the political economy perspective, the resilience framework stresses a different point. “Resilience approaches have tended to give predominant weight to the implications of social and environmental change across the broader geographic space, reducing human activity to just one of the driving forces and humans themselves as only one of the affected species” (Eakin & Luers, 2006 p372). This conceptualization of vulnerability is integrative in the sense that the social and natural (ecological) systems are mutually affecting one another, though there are political implications embedded within each of the three frameworks. Residing within this framework is the possibility for researchers or policy makers to minimize human or institutional responsibilities by suggesting that there are many other

factors perhaps more responsible for change than human activity, whereas the political economy framework makes the political implications much more explicit and central. The same potential for disassociation of responsibility lies in the risk-hazard framework as well.

Here again, as in the previous discussion about the two other conceptualizations of vulnerability, use of social process illuminates how research participants and practitioners in the field with a resilience orientation towards vulnerability have different value preferences and therefore pursue different outcomes and effects. Researchers endorsing the resilience conceptualization of vulnerability tend to view the effects of climate change *on landscapes, communities and livelihoods* as part of a natural rhythm or cycle where there will always be winners and losers in the short term, but in the longer term net analysis-the ecosystem as a whole establishes a new level of stability. This conceptualization tends to shy away from placing any emotional or anthropomorphic sentiments to what are considered natural processes. Seeing vulnerability through this framework could work against considerations of environmental justice, equity, and differential vulnerability (Adger, 2006).

Importantly, this third framework takes the longest temporal view on vulnerability of the three frameworks (O'Brien et al., 2007). The resilience framework recognizes that humans and our various societies have been interacting with the natural world for thousands of years and the nature of the relationship is constantly changing, while the risk-hazard framework primarily focuses on single climatic events and often makes projections based on modeling exercises. The view of vulnerability from the standpoint of the political economy framework falls

between the short-term view of the risk-hazard framework and the longer view of the resilience framework. The political economy framework focuses a good deal of attention to past events and makes projections based on historical circumstances. The resilience framework looks at the trajectory of the interaction between humans and the natural world to make projections about vulnerability from a regional perspective (Eakin & Luers, 2006), something the other frameworks do not do. Given the macro scale of this conceptualization, officials and researchers are often less prone to addressing questions, concerns, and values regarding social vulnerability at the individual or micro level (Eakin & Luers, 2006). Here, tradeoffs are made between focusing directly on the impacts to humans with positioning vulnerability to climate change as a process best understood by focusing on longer term trends.

Across the three frameworks, we see different research assumptions emerging from very different points of view and rationales. However, as Lasswell (1971) points out, our perspectives are quite subjective and not necessarily accurate or valid. Lasswell's observation remains relevant today, and could be expanded to include more current subtleties including considerations regarding standpoint and positionality. Therefore, it becomes important that practitioners practice and insist on reflexivity when it comes to studying vulnerability, and my three case studies are intended to do so.

The next section includes a discussion of my three case studies and research methods used in each. Additionally, I describe how the studies align with the two versions of rationality and the three conceptualizations of vulnerability.

### **Three Case Studies and Research Methods**

Looking at vulnerability from different perspectives is central to my analytical and methodological approach. Studying complex and dynamic issues such as vulnerability to climate change from various perspectives and through multiple research methods fosters a deeper understanding than is gained by having a methodology anchored to a particular viewpoint or position from which, as a researcher, you do not deviate substantially.

One of the key challenges facing vulnerability research according to Eakin and Luers (2006) is that of incorporating issues of equity and social justice into future assessments. My research strives to emphasize citizen participation in the co-creation of knowledge and policy, and does not presuppose the primacy of ‘scientific knowledge’ or technical rationality. Increasingly the participation of existing or potentially vulnerable populations in the evaluation of their vulnerability is recognized as being essential if assessments are to be useful for policy makers (UNDP 2004). Fisher (2000) notes three important contributions of citizen participation to the policy process. First, it provides a meaningful vehicle for citizens to exercise their democratic rights; second, it can help legitimize the creation and execution of policy; third, it can bring “to the fore new knowledge – in particular local knowledge” – to inform science (p244).

Critical to this effort toward improving and valuing public input, Fisher (2000) notes how the founder of the policy science movement, Harold Lasswell, outlined a “contextual orientation” beyond traditional professional practices and sought to emphasize local knowledge in a “search for new forms of knowledge and reason that carry us forward without the pretense of an unmovable universal “Truth”

(p252). This inclusive tendency towards alternative sources of knowledge informs my line of inquiry, aligns with cultural rationality, and is important from a practical and theoretical perspective.

During the research design phase, I strove to identify three case studies that examine issues of practical importance to communities. Through the course of several revisions, I settled on examining the willingness of North Carolina coastal officials to take climate change related adaptive action, the perspective of small-scale farmers in central North Carolina regarding climate change, and issues of public participation in water security issues in rural South Africa in the context of climate change. I include a line in Table 1.1 below clarifying my rationality and conceptualization of vulnerability as I began each of the three studies. However, these positions do not reflect predetermined conclusions about the studies but instead reflect a conscious effort to explicitly state my standpoint. A preview of the three case studies is shown below in Table 1.1 while a more detailed description of the case studies follows shortly thereafter.

Table 1.1 Overview of the three case studies

	<b>Coastal North Carolina (NC)</b>	<b>Chatham County, North Carolina (NC)</b>	<b>Hamakuya, South Africa (SA)</b>
<b>Unit of Study</b>	Individual level	Individual/Household level	Village level
<b>Research Question</b>	What threats from climate change do NC official's report in their community? ~ Corollary – does knowledge of climate change, political orientation, or perceived threat of climate change affect adaptive decision making?	How do small family farmers in Chatham Co., NC experience vulnerability to climate change? ~Corollary – what values inform their experiences of vulnerability to climate change?	How do water committee members in Hamakuya, SA evaluate the participatory processes at the village level regarding water resource management in the context of climate change.
<b>Methods &amp; Analysis</b>	Survey & Quantitative analysis	Photovoice (CBPR) & Qualitative analysis	Focus Groups & Qualitative analysis
<b>My Rationality as a Researcher</b>	Technical	Cultural	Cultural
<b>My Conceptualization of Vulnerability as a Researcher</b>	Risk-hazard	Access (subset of PE)	Political Economy

Table 1.1 presents the research questions for each of the case studies, the different levels of analysis and the research methods used to contextualize my understanding of vulnerability to climate change. For instance, the coastal study utilizes a survey and quantitative analysis to explore adaptive action of officials. The Chatham County study uses photovoice, a qualitative and participatory-based research method to study vulnerability, while the Hamakuya study looks at vulnerability at the village level through an assessment of participatory processes. The variety of methods and levels of analysis represents an intentional decision to examine vulnerability from a number of perspectives, and to be explicit about my orientation.

According to Brunner (2006) much of the policy research being conducted is often uncoordinated and lacks practical application. What is needed according to Brunner (2006) is a new *paradigm for practice*, one that makes the practitioners' paradigm more explicit, fosters new knowledge and practical solutions, and utilizes context-appropriate methods. Tryhorn and Lynch's (2010) research into the decision making process of local governments in the Alpine Shire of Australia regarding flood management follows through on Brunner's call and serves as an example of "an emerging paradigm of scholarship that requires an epistemology of reflective practice and action research at a local scale" (124). This reflective intention, seen in the work of these researchers and other policy scientists, rings true for me and informs my approach to conducting research. In doing so I am afforded a more comprehensive understanding of vulnerability to climate change by pursuing multiple levels of analysis, using mixed methods and approaching the issue from multiple conceptual orientations, than are researchers who might only study

vulnerability from one perspective. Where a researcher who chooses to explore vulnerability from a single angle or perspective and therefore is able to speak to just one or two audiences, I choose to create a multi-faceted understanding of vulnerability that will allow me to speak to several audiences instead of just one or two.

On their own, each of the studies offers a new perspective enhancing our collective understanding about vulnerability to climate change. One strength of this approach exploring vulnerability to climate change is how the studies offer an opportunity to integrate important commonalities between the various studies yet still contrast meaningful differences across them. The strengths and limitations of this approach are discussed in a concluding chapter.

Each of the following three mini-sections includes information illustrating areas where social process will be used either directly in the case studies or indirectly applied to participants who were not part of the data collection process. This will help to point out areas where the policy sciences can help address the hypocognition of current climate policy and gaps in vulnerability research.

### ***Coastal North Carolina***

This case study examines the understandings of risk of North Carolina coastal officials. I approached this project from a technical rationality standpoint and with a risk-hazard orientation towards vulnerability. The communities of coastal North Carolina are susceptible to multiple risks because of climate change, just like many other coastal communities in the United States. According to Riggs, Culver, Ames, Mallison, Corbett and Walsh (2008) coastal N.C. faces significant risk from sea-level

rise including: coastal erosion; increased flooding and salt-water intrusion; loss of infrastructure and barrier islands; along with reduced coastal tourism and recreational fishing activity, affecting two industries critical to the economic vitality of many of the coastal counties. The understandings of risk by coastal officials factors directly into their decisions regarding vulnerability to climate change and their willingness or reticence to initiate adaptive action in their communities. Therefore the adaptive decision making of coastal officials is an important factor worthy of exploration.

Researchers operating under technical rationality related to communicating risk tend to trust authoritative experts and methodological consistency, while emphasizing a narrow, reductionist analysis where risk is depersonalized (Plough & Krimsky, 1987); this may or may not hold true for coastal officials in NC. As stated in an earlier section of this chapter, risk-hazard orientation usually conceptualizes vulnerability as an isolated, external event impacting a system. As O'Brien et al. (2007) note an outcome (risk-hazard) orientation towards vulnerability may necessarily favor policy prescriptions designed around technological adaptations, strategies to reduce greenhouse gases (GHG), or some other sector-specific remedy.

However, according to O'Brien et al., (2007) researchers with a contextual orientation (political economy, access, or ecological resilience) towards vulnerability would tend to highlight policy prescriptions addressing power structures, local barriers constraining adaptive responses, or other social inequalities hindering collective improvements as relevant adaptive strategies. By examining how coastal officials differentiate between various risk scenarios related to climate change, this study creates practical significance for coastal officials and residents alike.

The various understandings of risk of coastal officials are assessed through an online survey. Surveys have been used in multiple locations to assess the climate change related attitudes, understandings, and perceptions of officials across the US (Safi, Smith, & Lui, 2012; Mozumder, Flugman, & Randhir, 2011; Brody, Grover, Lindquist, & Vedlitz, 2010). The survey instrument also asked whether officials believed that climate change is creating a crisis situation. Clark (2002) notes how “people behave differently in crises, whether they are ecological (Chernobyl or Bhopal), social (race riots), political (coup d’ etat), international (war), or otherwise” (p40). Determining the sense of urgency of climate change in the minds of the various county officials is important because there is not universal consensus among coastal officials regarding the threat of climate change to coastal N.C. (Riggs et al., 2008). Technical rationality might suggest that by generating an improved understanding of how coastal officials discriminate between potential risk scenarios, researchers and communication officials can tailor climate change information and messages more appropriately to maximize comprehension between real and imagined risks and offer improved adaptation strategies.

### ***Chatham County, North Carolina***

I approached this study thinking about cultural rationality and the access model, which is a subset of the Pressure and Release model (PAR) (Wisner et al., 2010) within the general political economy conceptualization of vulnerability. Access in this context is not the same as political access as used in the Trinity of Voice ToV model of public participation, but instead speaks to the social and economic assets and resources that a household leverages to sustain its preferred livelihood. This

study aligns with cultural rationality by valuing a broad understanding of appropriate sources of knowledge, is inclusive towards socio-cultural experiences, and favors a democratic process open to tradition and peer groups (Plough & Krimsky, 1987).

By utilizing photovoice, a participatory research method, this study actively includes alternative sources of knowledge to understanding the vulnerability of small-scale farmers to climate change. Through the study, the voice of small family farmer in central North Carolina are given a platform for leveraging their experiences to a broader audience than may have otherwise been available to them as individual farmers. Though the primary unit of analysis in this study is the individual farmer or farmer family, their individual experiences are intimately wedded to the local community, therefore their perspectives are understood to be representative of the community of local organic farmers in Chatham County.

The access model explores how vulnerability affects individual or household livelihoods (Wisner et al., 2010). This study with small-scale farmers does just that; it examines how the farmers and their livelihood strategies are being impacted by a changing climate. Practically speaking, this project seeks to privilege the local knowledge of small-scale farmers, continues the ongoing process of building and sharing knowledge in Chatham County about climate change and is supportive of advocacy initiatives at the local level. Furthermore the project involves working with a key partner and gatekeeper in the Chatham County sustainable agriculture movement and in assisting her in her efforts at moving the climate change agenda forward.

## ***Hamakuya, South Africa***

Hamakuya is a region within the Limpopo Province of northeastern South Africa. The way I have designed the Hamakuya study orients to cultural rationality and the political economy conceptualization of vulnerability. This study examined the perceptions of water committee members regarding public participation as derived from Senecah's model (2004), Trinity of Voice (ToV). The three key components of this public participation model are *access, standing* and *influence* (Senecah, 2004). ToV is a process-oriented model of public participation, which is an important consideration in my exploration of the decision space regarding water resource management in this particular setting. A discussion of the selection of this process-oriented model and how well it fits, or not, in this particular context is taken up in a subsequent chapter.

To make an initial and exploratory assessment of public participation in Hamakuya, I utilized a rapid assessment as the research method. Beebe (1995) notes how rapid assessments provide academic researchers and practitioners with “a preliminary, qualitative understanding of a situation” (p42). Conducting a rapid assessment allowed the project team to begin the process of understanding public participation in Hamakuya, and from the limited insights and lessons learned be in a better position to make informed decisions for a more exhaustive study of public participation in Hamakuya. We began by asking residents of Hamakuya about their experience regarding water. Focus groups were used to elicit the preferences and understanding of villagers who are water committee members about participatory practices related to water management and community decision-making. Questions inquired about villagers' perception about the quality, availability, and access of

water as well as the local rules, norms, and practices controlling water management in the villages. This study specifically positions the perceptions of villagers and water committee members regarding public participation as an integral and important source of knowledge. By including knowledge beyond that of the technical experts or government officials, and by broadly incorporating the value of peer groups as well as the social values of the community, this study adopts a cultural rationality.

This study fits within the political economy conceptualization of vulnerability because water governance in South Africa is very much a medley of legislative decisions at the national level operating alongside traditional rule at the village level that does not always work as well as it was intended (Redfern, Grant, Biggs, & Getz, 2003). The national government has limited resources to effectively manage all of the country's water resources especially those in the rural areas, while the rural communities often lack capacity in the form of information or authority (Malzebender, Goldin, Turton, & Earle, 2005) to make better decisions. Evaluating the effectiveness of the participatory processes through the villager's access, standing, and influence in terms of water resource management and aligns with my desire to explore social vulnerability to climate change by way of public participation.

By coupling the known lack of resources and limited institutional capacities with research exploring the participatory nature of the decision making processes, preliminary appraisals can be made about the effectiveness of water governance at the village level in the context of climate change. This study and the work of many others in Hamakuya represents an important and ongoing effort to understand the needs of the villagers, and determine whether the current practices and policies are effectively meeting the needs of the community.

Finding new and meaningful differences in regards to social vulnerability to climate is possible through the application of social process across these three case studies. By examining the perspectives, situations, strategies, outcomes and effects from different research orientations new insights are likely to emerge based largely on value preferences (Clark, 2002).

## **Concluding Remarks and Disciplinary Fit**

The long term arc of my research revolves around an effort to unpack how academic researchers and policy makers understand and communicate vulnerability to climate change. My research seeks to understand how risk is framed in studies regarding vulnerability to climate change through research design, construction, and problem orientation as well as exploring the environmental justice implications of this framing. Part of that process will include an examination of whether and how different forms of knowledge were either included or excluded from the policy process. Ascher et al. (2010) cogently state the power of knowledge biases in that “*who decides on what* knowledge is of crucial importance” (p11).

Academic researchers and policy makers studying vulnerability to climate change who examine how they approach the subject by critically questioning their assumptions and their framing of the issue and who use a variety of research methods are demonstrating a more robust methodology. Studying vulnerability from a diversity of perspectives can be a source of theoretical and practical strength, if researchers are willing and able to move beyond disciplinary gridlock in terms of how they think vulnerability should be studied.

Vulnerability studies are often conducted from a number of different, yet independent, perspectives including social, cultural, disciplinary, and economic perspectives. Carried along in the process of conducting such studies are the individual perspectives of the researchers, which are tightly wedded to their interests and frames of understanding. Frames are commonly understood as “cognitive maps or patterns of interpretation that people use to organize their understanding” (Cox, 2010 p181). Transcending these constructs and dichotomies is a key step to improving the study of vulnerability to climate change and something I intend to practice in my research.

In their discussion of intractable policy controversies, Schön and Rein (1994) note how “interests are shaped by frames, and frames may be used to promote interests” (29). Therefore, recognizing the frames used and their influence in shaping research and informing policy is key to improving the study of vulnerability to climate change. This would align with Brunner’s (2006) call for “policy scientists and other practitioners to make explicit and compare the paradigms underlying their own work” (p136), and my efforts in Table 1.1 of detailing my paradigm of practice. This is significant in terms of my exploration of vulnerability to climate change because the methodological choices we make and the assumptions we hold are driven by our individual framing of vulnerability and interests that eventually ripple throughout our studies and conclusions. My research moves the perspectives, rationales and conceptual frameworks regarding vulnerability to climate change to center stage as key decision points in understanding how vulnerability is gauged.

This nexus of perspectives, frames and interests matters in terms of how and what is researched regarding vulnerability. The researchers’ choice of rationality

informs their theoretical and operational conceptualization of vulnerability that in turn affects how and what research is conducted. This nested relationship between the researchers' rationale and their conceptualization of vulnerability creates their intellectual architecture for exploring vulnerability to climate change.

## **CLIMATE CHANGE AND ADAPTIVE DECISION MAKING: RESPONSES FROM NORTH CAROLINA COASTAL OFFICIALS**

Climate change is projected to increase the severity and frequency of sea-level rise, coastal erosion, flooding, salt-water intrusion, and loss of infrastructure and barrier islands, as well as reduce tourism expenditures, compromise ecosystems, and create multiple adverse public health issues in North Carolina (NC) (Riggs, Culver, Ames, Mallison, Corbett, and Walsh, 2008; Strauss, Tebaldi, Kulp, Cutter, Emrich, Rizza, & Yawitz, 2014). While the coast of NC has long been affected by tropical storms, hurricanes, tornados and other weather-related events, the long range future for coastal communities is of particular concern when coupled with climate change projections. The Intergovernmental Panel on Climate Change (2014) anticipates climate change will influence this recurring pattern among coastal communities, like those in NC. Though the scale and extent of the effects are uncertain, the likelihood of their occurrence is quite high (Wootten, Smith, Boyles, Terando, Stefanova, Misra, Smith, Blodgett, & Semazzi, 2014). Ultimately climate change will magnify the effects of naturally occurring events while simultaneously amplifying the complexity and importance of the adaptive decision making required by coastal officials.

However, consensus surrounding existence, causes, and effects of climate change is far from certain, and the potential impacts vary from location to location. Political and community will to act wavers as does ability, while those who are predisposed to take adaptive action are in many cases unsure of what to do or the potential payoff in terms of enhanced resilience. Additionally, the barriers facing

coastal officials are many, including legal, regulatory, information, financial, political and institutional factors (Spanger-Siegfried, Fitzpatrick, & Dahl, 2014).

## **Identification of the Problem and Institutional Setting**

Operating in a contested political environment can make it challenging for those inclined to take adaptive action and coordinate programs across agencies and levels of government. A report from the Nicholas Institute for Environmental Policy Solutions at Duke University (2010) found that many elected officials and public managers in eastern NC dispute the concept of climate change and are not convinced that climate change-induced sea level rise threatens their community. This resistance to believing the data supporting climate change and sea level rise along the NC coast stands to hinder these same officials and their communities from preparing for the challenges that lie ahead of them. These challenges include assessing infrastructure readiness, protecting drinking water supplies, securing wastewater treatment operations, managing flooding and water management issues, protecting estuarine and ecosystem health, planning for future economic development, as well as protecting public health (Nicholas Institute, 2010).

Climate change is a politically contentious issue in NC. Over the past four years, a battle has been brewing in the state over whether and how to study, plan for, or even acknowledge the anticipated impacts from climate change. A report by the NC Coastal Resources Commission's Science Panel on Coastal Hazards (2010) suggested that NC officials adopt 1 meter (39 inches) of sea level rise as the official projection for the coast of NC. That government report generated considerable backlash within certain segments of NC. NC-20, a conservative advocacy group

formed in 2009 to fight storm water management regulations in the 20 coastal counties of NC, quickly stepped in to oppose those findings and began working to convince the NC Legislature to dismiss its own report. Two years later, in 2012, with a newly elected Republican governor and a Republican-led legislature in place, the state passed a moratorium on any new sea level rise policies. The Science Panel from 2010 was disbanded and a new Science Panel was formed including of members of, or those sympathetic to, NC-20 on that new panel. This new panel is to look no more than 30 years into the future when making sea level rise projections. A preliminary draft report from this Science Panel was released for public comment in December 2014 (Dewitt, 2014) and then in early 2015 the Science Panel released their final report (NC Coastal Resources Commission, 2015). Even with the reduced time horizon that the Science Panel is instructed to use, the new report reiterates that NC can expect at least 2 inches of sea level rise along the southern coastline and 6 inches of sea level rise along northern stretches of the coast (Shutak, 2014; NC Coastal Resources Commission, 2015).

The contention surrounding climate change as seen in NC is not limited to NC. According to the Georgetown Climate Center (2014) seven coastal states including Texas, Louisiana, Mississippi, Alabama, Georgia, South Carolina, and North Carolina have failed to pass state-level climate adaptation plans. Moreover, the existence of locally or regionally-based adaptation plans in those seven states is marginal at best (Georgetown Climate Center, 2014). In fact, climate change pressures are exacerbating existing political tension in south Florida (FL) to such an extent that the Mayor and City Commission of the City of South Miami recently passed Resolution 203-14-14297 authorizing the division of FL in to two separate

states. The impetus behind this resolution comes not just from climate change pressure, but also from the fact that many officials in southern FL are open to the idea of climate change and have the corresponding willingness to take adaptive action while their colleagues in northern Florida are generally less supportive. The FL resolution contends that climate change is a scientifically proven reality and the impacts to the state should be considered safety issues instead of political levers to advance or hinder other agendas (Waddell, 2014).

The adaptive responses of coastal officials along the east coast of the U.S. run the gamut from strong statements of climate change denial to early adaptation projects such as the 1998 redesign of the Deer Island Wastewater Treatment Plan in Boston, MA (2011). Nevertheless, adapting to climate change, whether in NC or other states, is largely about addressing existing or emerging vulnerabilities, and there are many natural ecosystems and communities with substantially built environments along the NC coast that have such vulnerabilities (Nicholas Institute, 2010; Wootten et al., 2014). In fact, northern parts of the NC coast and the Outer Banks in particular are already experiencing sea level rise at a rate higher than the global average (Spanger-Siegfried et al., 2014).

Because there has been little to no peer-reviewed published research into the adaptive decision making of NC coastal officials, the willingness of those coastal officials to take adaptive action remains an open question. This study steps in to begin filling that gap in the literature. Climate change is an extremely complex issue with many moving and uncertain parts (IPCC, 2104) therefore, simplifying and reducing the causal links from projections about climate change to adaptive action provides a parsimonious mental model to begin to understand the determinants of

adaptive decision making. The conceptual model for this study positions 1) an official's knowledge about climate change, 2) their political ideology, 3) whether or not they perceive climate change as a threat to their community, and 4) the specific concerns of climate change as identified by municipal officials, as decision levers associated with adaptive action. Additionally and given the threats noted by Spanger-Siegfried et al., (2014); Nicholas Institute, (2010); Riggs et al., (2008) we wondered: What threats from climate change do NC official's report in their community?

Preston, Westaway, and Yuen (2011) note that many municipal officials have a "limited appreciation of the wider governance context in which both climate change and its management will manifest" (p426). In fact, little is known theoretically or empirically about the adaptive decision making of officials. According to Mozumder, Flugman and Randhir's, (2011) a significant portion of climate change research tends to focus on the perception of the general public to climate change, but does not inquire about the local officials regarding risk from climate change or their adaptive decision making processes.

There is considerable consensus among researchers and organizations studying climate change that adaptive action is a sound strategy to minimize the impacts of climate change. For instance, according to the Environmental Protection Agency (2014) the Southeastern US will need to take adaptive action to address climate change associated impacts on human health, coastal resources, water resources, and ecosystems to name but a few areas of concern. By its very definition, adaptive action is a process of planning, preparing, and adjusting for actual and anticipated impacts of climate change (IPCC, 2014) and is a critical intervention for

officials across multiple scales to undertake. Additionally, Smith (2011) demonstrated how planners and emergency management officials should incorporate both mitigation and adaptation principles into their pre-disaster response plans to strengthen community resiliency.

Researchers posit that mitigation responses typically require a coordinated regional approach, whereas those best situated to take adaptive action are local officials (Brody, Grover, Lindquist & Vedlitz, 2010; Tang, Brody, Li, Quinn & Zhao, 2011). Therefore, municipal officials are the unit of analysis for this study. The dependent variable is *the willingness of officials to commit resources to adaptive action*. Given the inherent uncertainty around the specific distribution, timing, and intensity of climate change impacts (NC Coastal Resources Commission, 2010; US Global Change Research, 2009; Riggs et al, 2008) NC coastal officials were presented with a variety of scenarios to determine willingness to take adaptive action. Officials were encouraged to think openly and broadly about what ‘resources’ meant to them and their community. Additionally, officials were instructed that operationalization of resources *could* include educational programs, economic incentives, new positions, funding new studies, forging partnerships, or regulatory measures. Officials were presented with five hypothetical climate change scenarios -- low risk, average risk, higher than average risk, very high risk, and uncertain level of risk -- and asked to identify their willingness to commit resources to take adaptive actions based on each of the scenarios. Specific comparative standards between the risk scenarios were not included to allow respondents to base their answers on their perception of the various levels of risk; though the five scenarios mirror the five risk

categories used by RealtyTrac to gauge risk from natural disasters to housing and infrastructure in North Carolina.

In this study, a targeted online survey was given to local officials along the NC coast to understand their willingness to commit resources to adaptive action regarding climate change. Survey responses provided both quantitative and qualitative data.

New theoretical understandings of the adaptive decision making process can help facilitate communication of pertinent and complex climate change information. Improved communication strategies will potentially offset both the knowledge biases of the broad community of academic researchers as well as the opinions and preferences of the coastal officials. Additionally, community managers and practitioners can benefit from a practical evaluation of knowing more about the factors that influence adaptive action by coastal officials. For instance, a local official might come to understand how their perception of climate change and the potential impacts align with that of their peers. If an official determines that he or she is an outlier among other coastal officials in terms of adaptive decision making, then that person might reevaluate their decision criteria. Adaptive decision making is an important issue for citizens and officials along the NC coast, and finding here might provide insights for researchers working on adaptation more broadly.

## **Knowledge, Perception, Ideology and Adaptive Action**

Researchers examining vulnerability to climate change along theoretical lines understand willingness to take adaptive action primarily as behavioral, technological, financial, regulatory, or capacity building responses (Funfgeld &

McEvoy, 2011). Smith (2011) suggests that there are some basic plan quality principles necessary for sound community and adaptive planning, but climate change adaptation-planning processes developed by local communities lack comprehensive assessment. The US Global Change Research Program (2009) suggests that being climate literate means having an “understanding of your influence on climate and climate’s influence on you and society” (p1), and improving climate literacy could play a significant role in facilitating climate change adaptation.

Many researchers concentrate on how information and knowledge about climate change act as drivers of adaptive action. Feldman, Maibach, Roser-Renouf, and Leiserowitz (2012) found positive correlations between a conservative source of news and information with less supportive attitudes concerning climate change acceptance. Yet Feldman et al. (2012) also stated how belief in climate change among some less conservative Republicans tends to increase as their source of cable news transitions from staunchly conservative to a more moderate or liberal channel, whereas support for climate change among Democrats does not change significantly depending upon their source of news. This is important because we see how political partisanship may not necessarily predict belief that climate change occurring. Mozumder et al.’s (2011) research on communities in the Florida Keys discovered awareness and serious concern among local decision makers about climate change, yet found a lack of institutional direction, funding, education and leadership in how to address the looming climate crisis. Kellstedt, Zahran, and Vedlitz (2008) explored the position that officials who are more aware of climate change, hence, more knowledgeable, are more likely to show concern about climate change and be motivated to take adaptive action. However, findings from their study (2008)

indicated that a higher level of knowledge or better information did not correspond with greater concern regarding climate change impacts. Furthermore, their study provided evidence undermining the knowledge-deficit model, which suggests that by improving or increasing the information that the general public receives will in turn move public opinion in better alignment with expert opinion regarding controversial topics. Hansen, Holm, Frewer, Robinson, and Sandøe found similarly weak support for models linking enhanced knowledge and risk-based decision making in their (2003) study regarding food safety. Although the model commonly situates public officials and technical experts as the knowledgeable group and the general public as those with the deficit, the present study modifies the models to position technical experts as those with the knowledge and elected or appointed officials (here, survey respondents) as those with deficient knowledge.

Having information or knowledge about an issue is not the same as being competent. For instance, researchers in the field of public health contend that a competent community is one that has both the capacity for self-assessment and the ability to create opportunities necessary for change they wish to occur (Eng & Parker, 1994). Furthermore, competency reflects an actively constructive systems approach to leveraging social capital to address community concerns and enhance community values rather than being a passive, receptive gap of understanding to be filled (Eng & Parker, 1994). Kinsella (2004) suggests that for public communities to be able to participate more fully in environmental decision making they must develop the requisite *public expertise* in the technical language frequently used in scientific publications and conversations. Developing this expertise is important if the public wishes to ask intelligent questions or understand the sometimes complex answers of

officials because officials commonly turn to technical studies to inform their decisions regarding complex issues like climate change. Competence and expertise mean more than possessing information or being aware of something, they are about leveraging what you know into the ability to execute change.

Taken together these studies create doubt about whether simply providing coastal officials with more or better information about climate change will necessarily lead to adaptive action. While this study would like to suggest that knowledge and information are important links working together to form the foundation of adaptive decision making, the literature is inconclusive. This situation suggests the following research hypothesis:

H1: There is a direct relationship between an official's perceived knowledge about climate change and their willingness to take adaptive action.

Other researchers are investigating adaptive action to climate change empirically to understand how perception of a threat is associated with action to deal with that threat. The (2010) Brody et al., research surveyed public sector officials from across the country and found a strong connection between threat of a dramatic climate event and local adaptive action noting, "without it decision-makers have little tangible evidence with which to link a solution, and associated resources and organizational initiative" (p600). Repetto's (2008) findings are supportive of Brody et al.'s, (2010) work, noting that people typically place too much emphasis on recent dramatic events while unduly discounting slower or less perceptible trends such as climate change. Concerns from threats such as sea level rise attract many researchers

to study coastal adaption efforts. Tang et al., (2011) examined the adaptive efforts of communities in California, Oregon, and Washington to understand how a perceived sea level rise threat was associated with local climate change policy initiatives. Based on their findings the coastal proximity of a particular community did not by itself explain a higher incidence of local climate change policy initiatives, but instead the level of vehicle emissions was found to be most predictive of local climate change action. Vehicle emissions are largely visible, directly related to air quality, and create a somewhat safe issue for public officials to take on in the name of health and sustainability. My study assumes officials who perceive that their community faces a threat from climate change will be more willing to take adaptive action than those who do not perceive climate change as a threat. Therefore, as the perceived level of risk increases so too would the willingness of officials to take adaptive action, suggesting a second research hypothesis:

**H2:** There is a direct relationship between an official's perception that their community faces a threat from climate change and their willingness to take adaptive action.

Considerable research is conducted on the relationship of political partisanship and climate change. Political orientation or partisanship, partisan attitude, political affiliation, and political ideology all speak to the same general construct and are exceptionally common variables in climate change related studies (Pew Research Center, 2010). Value preferences are typically expressed as news preferences and political preferences, and appear to be intricately bound. In fact, the

Pew Center (2010) finds a commonly recurring relationship between political partisanship and a variety of factors such as support for environmental policies, belief in climate change, and willingness to support action on climate change policies.

Decisions about climate change do take place in a political environment. Krause (2012) notes how climate change is a particularly partisan issue in the US and therefore a legitimate topic for researchers to examine. A 2014 McCright, Xiao, and Dunlap study looked at the effect of political polarization on government spending for environmental programs. McCright et al. (2014) found that support for environmental policies depends significantly on the partisan ideology and identification of the person. More recently, Campbell and Kay (2014) suggested that people might experience ideological aversion to certain policy solutions regarding complex problems while at the same time not being ideologically averse to the underlying problem. Bedworth and Hanak (2013), conducting research in California, found that partisanship does affect the implementation, effectiveness, and support for climate policies. Beatley (2009) identifies nine barriers to building coastal resilience, one of which is political impediments. “Limiting development in high-risk locations often results in significant political opposition, especially in coastal areas. Local elected bodies often reflect a disproportionate representation of real estate and development interests, and therefore often reflect and express a growth-oriented viewpoint” (Beatley, 2009 p47).

Research appears to support that the political leanings of an official matter when it comes to climate change. We know this from the work of those mentioned above, and especially from the work of McCright and Dunlap (2003; 2010) who have

been something of a lodestar in examining the influence of political ideology and party affiliation on a host of environmental issues including climate change.

However, we do not know if this is true for NC coastal officials. Therefore it is fitting to include political ideology in this study testing to see whether ideology is a factor affecting adaptive decision making. A third hypothesis examines that possibility:

H<sub>3</sub> : There are differences between liberal, moderate, and conservative officials willingness to take adaptive action.

Knowledge, perceptions of threat, and ideology make for powerful framing structures that can confine and define problems and policies related to climate change. Framing is important in environmental issues, including climate change, because the frame can create impetus for action or inaction. Dupois and Knoepfel (2013) quote Ward, Donaldson, and Lowe (2004) noting that problem framing consists in “the selective use of knowledge and information about a problem and the causal relationships surrounding it, to give it meaning and render it manageable” (p31). Peters (2005) notes how problem framing is directly linked to policy design, outputs, and implementation protocols, and therefore is capable of facilitating and improving adaptive decision-making. Similarly, Steelman’s (2010) analysis of organizational efforts aimed at fostering innovation and policy implementation found how framing practices and strategies significantly shape and realign people’s attitudes and understandings of a problem. From this understanding, it becomes clear how the choice of the problem frame restricts the parameters of the problem, and suggests what knowledge is appropriate to consider during the policy design and

implementation phases (Ascher, Steelman, & Healy, 2010; Fischer, 2000; Schön & Rein, 1994). Within the context of this study, knowledge, perception and ideology are potential sources of frames that could influence action of NC officials.

## **Study Area**

North Carolina has considerable human, social, environmental, and built capital along the coast. NC has 484km of direct shoreline and 5,432 km of waterfront property when factoring in the rivers, lakes, sounds, and other waterways of the inner banks. Development along the outer banks of NC is largely confined to a narrow band of land ranging from less than 1 km wide to as much as 3 km at its widest point.

Within North Carolina, there are 20 coastal counties with population ranging from 202,667 people in New Hanover County to only 4,407 residents in Tyrrell County, all situated along the southeastern coast of the United States (U.S. Census, 2010). New Hanover County has over 101,000 housing units while Tyrrell County has fewer than 2,100 housing units; these two counties and the other eighteen coastal counties are all on a frontline of climate change (U.S. Census, 2010). Within the coastal areas and lying below the 4-foot mean high tide line, there is an estimated \$8 billion in property including “15 schools, more than 100 churches, and 131 EPA-listed sites such as hazardous waste dumps and sewage plants” (Strauss et al., 2014 p16). Given these resources, where they are situated, and the potential for further exposure due to climate change – local coastal officials are facing some tough decisions regarding whether and/or how to prepare for the anticipated consequences. Figure 2.1 shows the twenty coastal counties of NC.



Figure 2.1 Coastal counties of NC

Source: NC Division of Coastal Management (2014)

## Methods

The survey population consists of city and county level public officials or employees, residing in each of the twenty coastal counties of NC who might face issues related to climate change (either directly or indirectly) during the tenure of their position. A purposive sampling frame was assembled by conducting an online search, and by calling and emailing offices and officials throughout all twenty

counties to solicit their participation and gain accurate contact information for an on-line survey. A list of 299 potential participants was generated through the original solicitation. A final population list of 283 officials emerged after omitting those participants who had emails bounce back as undeliverable.

The survey was divided into three sections (Appendix A). Section 1 contained demographic questions about age, education, years in profession, professional title, political affiliation and ideology as well as their preference for news and information. Section 2 asked about the location of the official's community and its relation to waterfront property. Section 3 asked questions specifically about climate change. For example, respondents were asked whether they believe that climate change poses a threat to their community or not? Responses were measured numerically on a 1-5 scale where 1=strongly disagree and 5=strongly agree. The survey questions and answer choices were pilot tested for clarity with similarly positioned officials in non-coastal counties across North Carolina. Feedback was received from a variety of officials including a Disaster Response Program specialist, Emergency Services official, Storm Water Infrastructure manager, Assistant County Manager, as well as a Planning and Development Manager and revised accordingly.

Survey questions pertaining to the five risk scenarios were presented as follows:

- Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces a **Low level** of risk or vulnerability from climate change...given this scenario how likely would you, as a community official be to commit resources to take adaptive action?

- Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces an **Average level** of risk or vulnerability from climate change...given this scenario how likely would you, as a community official be to commit resources to take adaptive action?
- Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces a **Higher than Average level** of risk or vulnerability from climate change...given this scenario how likely would you, as a community official be to commit resources to take adaptive action?
- Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces a **Very High level** of risk or vulnerability from climate change...given this scenario how likely would you, as a community official be to commit resources to take adaptive action?
- Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces an **Uncertain level** of risk or vulnerability from climate change...given this scenario how likely would you, as a community official be to commit resources to take adaptive action?

None of the non-coastal officials who pilot tested the survey and offered feedback, or coastal officials who took the survey, or study team who reviewed the survey instrument questioned the scenarios or asked compared to what. Since this particular study was more interested in exploring social or cultural understanding of climate change as a threat to the NC coast than a technical risk assessment, we were pleased to see that officials did not express any problem with the risk scenarios. Additional modifications to the survey were completed after the pilot test to address issues regarding response rates including: issue saliency, timing of the survey, font size, and length and complexity of the survey (Connelly, Brown, & Decker, 2003). The survey contained 23 questions requiring no more than 10 minutes to complete. The survey instrument was reviewed, edited, and approved by a cadre of Communication, Forestry, and Policy Sciences faculty prior to being launched using Survey Monkey software program. The survey was live for four weeks in March and April of 2014. The timing of the survey was designed to avoid peak periods of tourism travel beginning with the Memorial Day holiday or intense pressure from summer or fall hurricane season. Weekly emails reminders were sent out in accordance with Dillman et al. (2010).

The NC Division of Coastal Management considers fifteen of the twenty coastal counties as northern and five as southern counties. The northern counties are more susceptible to sea level rise than Southern counties because there is more geological subsidence (ground sinking) in areas north of Cape Hatteras, and due to the position of the Gulf Stream (Riggs et al 2008). Of the 283 valid email addresses, 182 surveys went to officials in northern counties while 101 went to officials in

southern counties. Of the 283 officials contacted, a total of 106 individuals followed the link to participate in the study.

The adjusted survey response rate was 38%, which represents the total number of surveys completed divided by [total number sent minus those returned as undeliverable]) (Connelly et al. 2003). Random error led to missing data, therefore inferential statistical tests were conducted on (N=88) completed data responses. Response bias was tested by comparing the descriptive statistics of gender, age, education, and political ideology of respondents from the first round of responses with those of the second round of responses as was similarly done by Safi, Smith, and Lui (2012). No significant differences were found between those responding during the first solicitation and those responding during the second round.

Once the survey closed, the data set was organized and uploaded to SPSS 20.0 (Statistical Programming for Social Sciences; IBM Corp., 2011) for analysis. In addition to the quantitative data, the survey instrument also contained questions designed to gather qualitative data through a series of open-ended questions. Qualitative responses to a question asking about the top three threats to respondents' community from climate change were entered into Atlas.ti 7.1.3 for deductive coding. Eight codes and eight sub-codes for the responses to the open-ended questions were largely synthesized from four different, but equally relevant, resources pertaining to coastal climate change issues. Survey responses were compared to threats mentioned in the literature (National Climate Assessment, 2014; Gregg, Hansen, Feifel, Hitt, Kershner, Score, & Hoffman, 2011; EPA, 2008; Riggs et al., 2008). Four additional codes and two sub-codes were added to the codebook based on responses by the coastal officials (Appendix B). Coding of open-

ended responses was cross-checked with two external coders to verify reliability resulting in a Cohen's kappa value of .82. According to Altman (1999) a kappa (k) value above .80 represents very good strength of agreement between coders.

## Results

The majority of respondents are categorized as Planners or Zoning Managers, followed by Town Managers, County Managers, and Environmental Managers. Officials from Finance departments, Mayors, Health and Social Services, Emergency Response and GIS officials also responded (Table 2.1). Respondents include elected officials and those appointed to agency or staff positions.

Table 2.1 Professional title of respondents (n=88)

Title	Frequency	Percent
Planning-Zoning Manager	28	31.8
Town Manager	22	25.0
County Manager	9	10.2
Environmental Manager	7	8.0
Finance Manager	5	5.7
Health-Social Services	5	5.7
Mayor	4	4.5
Emergency Service	3	3.4
GIS	3	3.4
Unspecified	2	2.3
Total	88	100

Additional data show that over 43% of survey respondents reported being employed in their profession for 15 years or more. Educational demographic data from the survey respondents is provided in Table 2.2. More than two-thirds of the coastal officials (70.5%) held a Bachelor's degree or higher, suggesting a well-educated sample of officials.

Table 2.2 Education of respondents (n=88)

<b>Grade</b>	<b>Frequency</b>	<b>Percent</b>
High School	10	11.4
Assoc. or Tech Degree	12	13.6
Bachelor Degree	32	36.4
Master or PhD	30	34.1
Medical or Juris Doctor	3	3.4
Missing	1	1.1
Total	88	100

Interestingly, 22.7% (n=20) of respondents said they were just slightly informed about climate change, 59% (n= 52) said they were moderately well informed, 17% (n=15) said they were very well informed, while only 1 respondent said they were not at all informed about climate change. The next section will address findings related to the research hypotheses.

Coastal officials identified their political ideology in discrete categories as either: Very Liberal, Liberal, Moderate, Conservative, Very Conservative, or Libertarian. Respondents self-reported their political ideology, as they did for all other questions in this survey including education. Although some researchers

(Nisbett & Wilson 1977) issued a word of caution regarding the limitations of respondents self-reporting due to complex and not fully recognized cognitive processes, Napier and Jost (2008) and Jost (2006) found the use of self-identification for ideology to be robust in terms of reliability and predictive validity. The distribution of survey respondents appears to be more moderate and significantly less liberal in terms of political ideology compared to participants in a national survey conducted by USAToday/Gallup (2014). Both the Pew Research Center and Gallup/USA Today report nearly identical numbers for political ideology of the American public, though only the Gallup/USA Today numbers are reported below.

Table 2.3 Self-reported political ideology of respondents

<b>Ideology</b>	<b>Gallup/USA Today 2011</b>	<b>Current study</b>
	%	%
Very conservative	10	3.4
Conservative	30	34.1
Moderate	35	51.1
Liberal	15	5.7
Very liberal	6	2.3
Libertarian	0	1.1
No Opinion	4	2.3
<b>Total</b>	<b>100</b>	<b>100</b>

Adapted from Gallup (2014)

A majority of respondents self-reported as moderate. An unusually low number of respondents self-reported as being either liberal or very liberal.

### ***Hypothesis testing***

As a reminder, officials were presented with five hypothetical climate change scenarios, low risk, average risk, higher than average risk, very high risk, and uncertain level of risk, and asked to identify their willingness to commit resources to take adaptive actions based on each of the scenarios. The wording of the questions was identical except for substituting the five different levels of risk. The exact questions read:

- Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces a **Low level** of risk or vulnerability from climate change...given this scenario how likely would you, as a community official be to commit resources to take adaptive action?

The mean and standard deviation for each of the test variables is shown in Table 2.4 below. Values for knowledge about climate change were measured on a scale from 1=not at all informed to 4 very well informed. Values for “community faces a threat from climate change” were measured on a scale from 1=strongly disagree to 5=strongly agree. As noted previously, values for ideology was measured discretely as detailed previously.

Table 2.4 Mean and standard deviation for test variables

<b>Variable</b>	<b>Mean (M)</b>	<b>Standard Deviation (SD)</b>
Knowledge	2.92	.664
Threat	3.44	1.027

H1: There is a relationship between an official's perceived knowledge about climate change and their willingness to take adaptive action.

Correlations for the variable, personal knowledge about climate change and willingness to take adaptive action is shown in Table 2.5.

Table 2.5 Correlations for personal knowledge

<b>Variables</b>		<b>Knowledge</b>
Personal Knowledge of Climate Change	Pearson Correlation	1
	Sig. (2-tailed)	
	N	88
Low Risk	Pearson Correlation	-.113
	Sig. (2-tailed)	.294
	N	88
Avg. Risk	Pearson Correlation	-.141
	Sig. (2-tailed)	.191
	N	88

Table 2.5 Continued

<b>Variables</b>		<b>Knowledge</b>
Higher than Avg. Risk	Pearson Correlation	-.095
	Sig. (2-tailed)	.381
	N	87
Very High Risk	Pearson Correlation	-.202
	Sig. (2-tailed)	.059
	N	88
Uncertain Risk	Pearson Correlation	-.159
	Sig. (2-tailed)	.140
	N	88

To test the first hypothesis, a Pearson product-moment correlation was conducted. The respondents who were unsure of their knowledge (e.g. they checked “Do not know”) were omitted from the analysis. None of the correlations was significant at the .05 level, for instance, results for personal knowledge and low risk show,  $r(86) = -.11$ ,  $p=.294$ . A similarly negative, non-significant relationship ( $p = .14$ ) was found between personal knowledge and uncertain risk,  $r(86) = -.16$ ,  $p>.05$ , therefore, H1 was not supported.

H2: There is a relationship between an official’s perception that their community faces a threat from climate change and their willingness to take adaptive action.

A Pearson product-moment correlation was conducted to explore this hypothesis. Correlations for the variable, perception that my community is threatened by climate change and willingness to take adaptive action is presented in Table 2.6.

Table 2.6 Correlations for perceived threat

<b>Variables</b>		<b>Community Threatened by Climate Change</b>
My community is Threatened by Climate Change	Pearson Correlation	1
	Sig. (2-tailed)	
	N	88
Low Risk	Pearson Correlation	.463**
	Sig. (2-tailed)	.000
	N	88
Average Risk	Pearson Correlation	.564**
	Sig. (2-tailed)	.000
	N	88
Higher than Avg. Risk	Pearson Correlation	.564**
	Sig. (2-tailed)	.000
	N	87
Very High Risk	Pearson Correlation	.544**
	Sig. (2-tailed)	.000
	N	88
Uncertain Risk	Pearson Correlation	-.006
	Sig. (2-tailed)	.954
	N	88

\*\*Correlation is significant at the 0.01 level (2-tailed)

Four moderate, direct, and statistically significant correlations were found for this hypothesis as shown in Table 2.6 including: low level, average level, higher than average level, and very high level of risk. No significant correlation was found for the uncertain level of risk. We made the assumption that officials who perceive that their community faces a threat from climate change will be more willing to take adaptive action than those who do not perceive climate change as a threat. Therefore, as the perceived level of risk increased so too would the willingness of officials to take adaptive action.

A linear regression was conducted to further examine this hypothesis (Table 2.7). The regression used official's perception that their community faces a threat from climate change as the predictor variable and the official's willingness to take adaptive action under each of the five scenarios as the criterion variable.

Table 2.7 Regression analysis for perceived threat

<b>Risk Scenarios</b>	<b>R Square</b>	<b>B</b>	<b>SE B</b>	<b>b</b>	<b>p=.05</b>
Constant		1.117	0.349		
Low Risk threat from Climate Change	.214	0.471	0.097	0.463	.000*
Constant		1.214	0.328		
Average Risk threat from Climate Change	.318	0.578	0.091	0.564	.000*
Constant		1.85	0.335		
Higher than Avg. Risk threat from Climate Change	.318	0.589	0.094	0.564	.000*

Table 2.7 Continued

Risk Scenarios	R Square	B	SE B	b	p=.05
Constant		2.196	0.344		
Very High Risk threat from Climate Change	.296	0.577	0.096	0.544	.000*
Constant		4.160	3.883		
Uncertain Risk threat from Climate Change	.006	-.063	1.081	-.006	.954

\*Results that are statistically significant at the .05 level

Preliminary interpretation of the linear regression results indicate that perceiving climate change as a threat appears to be a statistically significant predictor of an official's willingness to commit resources to take adaptive action, but not a significant predictor under the uncertain risk scenario.

H3: There are differences between liberal, moderate, and conservative officials willingness to take adaptive action.

The political ideology of respondents and their willingness to take adaptive action was tested to see whether there were significant differences between groups. For the analysis, a composite measure of three groups was created by combining very conservative with conservative, very liberal with liberal, and a group of moderates. Because the number of liberals was low, a harmonic mean (13.628) was used to compensate for the low number of respondents. The composite measure of the three groups was used to run a one-way between subjects ANOVA and post-hoc tests for this hypothesis under each of the five levels of risk. Therefore, five separate ANOVAs were conducted, one for each level of risk. Table 2.8 depicts a summary of the results.

Table 2.8 ANOVA results for ideology

Level of Risk		Sum of Squares	df	Mean Square	F	Sig.
Low	Between Groups	3.055	2	1.528	1.403	.252
	Within Groups	87.113	80	1.089		
	Total	90.169	82			
Average	Between Groups	9.232	2	4.616	4.896	.010
	Within Groups	75.419	80	.943		
	Total	84.651	82			
Higher than Average	Between Groups	9.191	2	4.596	5.098	.008
	Within Groups	71.211	79	.901		
	Total	80.402	81			
Very High	Between Groups	11.321	2	5.660	6.532	.002
	Within Groups	69.330	80	.867		
	Total	80.651	82			
Uncertain	Between Groups	6.387	2	3.193	3.966	.023
	Within Groups	64.408	80	.805		
	Total	70.795	82			

The Tukey HSD test was used for all post hoc comparisons. Post hoc comparisons under the average risk scenario indicate that the mean score for moderates ( $M = 3.53$ ,  $SD = .944$ ) was significantly higher than the conservatives ( $M = 2.84$ ,  $SD = .987$ ). Post hoc comparisons under the higher than average risk scenario indicate that the mean score for moderates ( $M = 4.20$ ,  $SD = .878$ ) was also significantly higher than the conservatives ( $M = 3.66$ ,  $SD = .100$ ). Additionally, the mean score for liberals ( $M = 3.17$ ,  $SD = 1.17$ ) was significantly lower than that of moderates ( $M = 4.20$ ,  $SD = .878$ ) under the higher than average risk scenario.

Under the very high risk scenario, the mean score for moderates ( $M = 4.56$ ,  $SD = .785$ ) was significantly higher than both the conservatives ( $M = 3.91$ ,  $SD = .995$ ) and the liberals ( $M = 3.50$ ,  $SD = 1.52$ ). And finally, under the uncertain risk scenario the mean score for moderates ( $M = 3.13$ ,  $SD = .786$ ) was significantly higher than the conservatives ( $M = 2.56$ ,  $SD = .105$ ).

Hypothesis 3 was supported. The ANOVA analysis indicates that political ideology does have an effect on an official's willingness to take adaptive action. Specific post hoc results suggest:

- When the risk is determined to be average, moderates were more likely than conservatives to commit resources
- When the risk is determined to be higher than average, moderates were more likely than either liberals or conservatives to commit resources
- When the risk is determined to be very high, moderates were again more likely to commit resources than either liberals or conservatives
- When the risk is uncertain, moderates were more likely than conservatives to commit resources

- When the risk is determined to be low, there were no significant differences between liberals, moderates, or conservatives in terms of their likelihood of committing resources to adaptive action

Interestingly and recalling Table 2.3, self-described moderates comprised the largest portion of survey respondents followed by conservatives, which coincides with the leanings of the general population (Gallup 2014; Pew 2010). These findings support the literature showing political ideology having some effect on support for climate change. Additionally, findings from this study align with the inconsistent conclusion from the literature which fails to show a cause and effect relationship from political ideology across a spectrum of climate change scenarios.

- Qualitative probe asked: What are the top three threats to your community from climate change?

Table 2.9 presents some of the responses and frequency of those responses to our open-ended question. The percentage totals sum to more than 100% because respondents were able to provide three answers. A perceived threat from precipitation, and a separate threat from sea level rise, resonated with nearly one out of every three respondents surveyed. Additionally, a full 25% of those surveyed expressed concerns over potential flooding, agricultural crop damage or negative economic impacts from climate change.

Table 2.9 Perceived threats from climate change

<b>Threat</b>	<b>Number of mentions</b>	<b>% of Total</b>	<b>Sample quotes</b>
Precipitation (frequency & intensity)	29	32%	“if strongly believed in [climate change] substantial intensity increase of storms, i.e. hurricanes, thunderstorms, etc.”; “more extreme weather patterns, i.e. higher chances of severe storms”; “severe t-storms”
Sea Level Rise (SLR)	27	30%	“rising sea levels causing our wetlands to disappear”; sea level rise”; “related shoreline erosion”; “rising water impacts to septic health”; “flooding from sea level rise”
Precipitation (flooding)	23	26%	“localized flooding”; “flooding related to an increase in water temperatures that in turn make conditions favorable for hurricanes”; “rising water along the rivers and their tributaries”
Agricultural or other Crop Damage	22	25%	“season shifting causing problems for agriculture and native vegetation”; “many farmers in the area would be affected”; “crop flooding”
Economic Impact	22	25%	“Sea level rise hurting local economy/housing” & “economic impact - higher water and poorer air quality”
Information (more or accurate)	2	2%	‘accurate and correct information” & “more information needs to be provided to our community on this subject”

Additional qualitative data were solicited from the respondents through an open-ended question asking them to share any additional information or comments about climate change that they felt was important. A sample of their comments appear below, with comments considered skeptical of climate change and comments considered amenable to believing in climate change and adaptive planning. The comments provided additional insights into whether and how NC coastal officials are thinking about climate change as a threat to their community. The comments also shed insights into why some NC coastal officials do perceive climate change as a threat to their community.

#### *Skeptical comments*

- Decision making by local officials will be based upon actually seeing changes, probably not before that happens. There is significant skepticism locally of scientist's projections
- Man made global warming has been overhyped and found to be pseudoscience. True climate change has always occurred and always will.
- I feel that climate change is being used as a byword in order to prompt social change, which probably is not a good idea.
- We have just experienced the coldest winter in 100 years according to national news reports, so I think there is some skepticism about the climate change forecast.
- There is too much conflicting information and, at times, hysteria surrounding this issue.

### *Amenable comments*

- It would be best served to not act alone as a single community but to address this more on a regional level to pull together resources and act as a collective group sharing ideas.
- Officials around here should take greater initiative in contingency planning. Everyone seems to be too laid back or indifferent to preparing for the future.
- The majority of my community is unaware and/or unconcerned with the threats posed by climate change. A comprehensive education plan is needed to raise awareness and stimulate action.
- The key for me would be developing a policy of adaptability. That is, a policy that would recognize that policy will have change at some future date and would establish trigger points for significant policy changes.
- Local decision making in land use must deal in specifics. "Climate Change" encompasses a lot of things. Communities must deal with storm water, storm planning and response, infrastructure and hazard mitigation, floodplain management, zoning and land conservation. All of these things in their way are related to adapting to current and predicted environmental conditions, but not everyone is calling it climate change planning.

Respondents provided a wide range of opinions about climate change and adaptive planning. Responses indicated there is considerable disagreement among NC coastal officials about climate change and the need to take adaptive action or not.

## **Discussion**

The aim of this study was to investigate how NC coastal officials differentiated between various risk scenarios in determining whether or not to take adaptive action on climate change while also addressing decision making processes more generally. Hypothesis testing was conducted looking for significant differences in the adaptive decision making of public officials from twenty counties in eastern North Carolina. The questions broadly guiding this study were: What are the critical levers that induce a public official to take climate change related adaptive action? Are officials who express a greater knowledge of climate change more likely to take adaptive action? Are political ideology or perceived threat from climate change enough of a motivating factor to compel local officials to take adaptive action? What types of threats to climate change do official's identify in their community?

This study found that knowledge and political ideology were less important than a perceived threat from climate change in explaining willingness to take adaptive action. Findings indicated that perceived knowledge about climate change may not motivate NC coastal officials to take adaptive action. Though 76% of respondents said they were at least moderately well informed about climate change, that knowledge did not predict willingness to take adaptive action. This finding is not entirely surprising, especially considering the literature on the topic. Research findings in this study support Kellstedt et al. (2008) who found no significant link between awareness, or more knowledge, about climate change and an increased motivation to take adaptive action, while also offering further evidence questioning the knowledge-deficit model along the lines of Hansen et al. (2003).

Since findings from this study show little support for the knowledge deficit model, which is in line with the growing body of literature, it is questionable whether merely increasing or improving the information coastal officials receive about climate change in general will be sufficient to initiate adaptive action. This raises an important question about what *will* drive change, or whether some officials even believe change is needed. Recalling the skeptical responses, one official suggested “there is too much hysteria about climate change.” Another official expressed skepticism about climate change noting that their community just experienced their coldest winter in 100 years. A third official suggested that local officials would not adapt until they actually see changes in their community resulting from climate change, noting widespread skepticism in the community about climate change.

Additionally, the data from this study suggest that coastal officials are reluctant to take action while the specificity of the threatening impacts from climate change remain uncertain. This is troubling because climate scientists suggest we should be more proactive given the looming nature of the threat (US EPA, 2014; Riggs et al., 2008). Delaying decisions and adaptive planning until a bulk of the uncertainty surrounding climate impacts is removed not only means waiting for years or decades, but also squanders valuable time that could be better used now through public forums, regional meetings, and information sessions to talk about community-wide priorities (Smith, 2011). Brody et al. (2010) further drive home the point about the need for local leadership, “adaptation measures, in particular, fall squarely in the domain of local planners. Our findings, however, suggest that these agencies and actors have yet to strongly embrace this eventuality” (p601). Reframing climate change as an exigence for preventative action, rather than a threat to be

reacted to might resonate better with NC officials. Some of the qualitative responses from Table 2.9 indicated that coastal officials are concerned about the well-being of their communities especially given the potential for water-related impacts associated with climate change. The hesitancy of officials to adapt under conditions of uncertainty could provide scholars and practitioners with an opportunity to explore discrepancies between what the officials understand the risks to be, what the scientists and the literature indicate the risks are, and how different values and information are being communicated, indulged or overlooked.

Our data also suggest that leadership and adaptive action are more likely as perceptions of risk increased. Contrary to the earlier findings related to knowledge about climate change and willingness to take adaptive action, when coastal officials perceive that climate change poses a direct threat to their community they are much more likely to take adaptive action. Researchers and practitioners should exercise caution in inaccurately categorizing coastal officials as a homogenous group, but instead remember that officials are subject to different forms of political, institutional, and professional influence. This study found evidence of H2 under the low, average, higher than average, and very high risk scenarios but not for the uncertain level of risk. Findings from this study of NC coastal officials are somewhat contradictory to the findings of Mozumder et al. (2011) regarding officials in the Florida Keys. Here, NC officials who feel climate change poses a threat to their community report being willing to take adaptive action. However, Mozumder et al. (2011) found officials in the Keys very aware of the threats that climate change poses to the Keys, most urgently-sea level rise, but their willingness to take adaptive action was lacking. The results from this research are encouraging, but begged the question

of whether and how action would be taken under uncertain risk scenarios, and perhaps how low, average, higher and very high risk would be perceived by coastal officials.

Because responses indicated significant differences in willingness to take adaptive action depending on knowledge and perceived threat, we surmise that officials did not have issues with the construction of the risk scenarios, that they did make a distinction between knowledge and threat thereby not conflating the two concepts. We suggest that the addition of follow up qualitative interviews would have bolstered the findings.

Political ideology was found to have some influence on willingness to take adaptive action, but ideology was not as significant of a factor as perceived threat. Local officials face many difficult choices with multiple and complex tradeoffs, especially when it comes to climate change policies. Tang et al. (2011) note issues with economic, environmental, and social motivation along with perceptual, institutional, and implementation constraints, not to mention the conflicting issues over jurisdictional or regulatory power. This constellation of concerns and uncertainty surrounding climate change is problematic because local officials are somewhat at the mercy of information produced from external partners yet they remain the public face of the issue and its management. Additionally, NC coastal officials expressed concerns related to water and flooding, changes in precipitation patterns, and potential economic impacts to the communities. This study found that moderates were more likely to take adaptive action to climate change than even liberals. Given the contentious nature of climate change, self-reporting as a moderate

might have been seen by some officials as a safer or more socially desirable answer choice than either liberal or conservative.

A cautionary note regarding the findings is in order. Findings related to moderates should be interpreted with caution to a perceived low sample size, allowing respondents to self-report for key variables as well as individual interpretations of descriptors such as liberal and conservative that might skew findings regarding ideology. Comparing the finding in this study with future research regarding this study population that incorporates multiple questions about ideology would prove insightful to determine the efficacy of the work presented here. Nevertheless, the findings support two of the three hypotheses. Moderates appeared more likely to take adaptive action than conservatives, but under none of the five scenarios were liberals more likely than conservatives to take adaptive action. Future research should re-examine these findings after attempting to solicit a larger subgroup of liberals among NC coastal officials, and by measuring political ideology through multiple items instead of self-reporting (c.f. Nisbett & Wilson 1977; Napier & Jost 2008; Jost 2006). Our findings related to this hypothesis are somewhat inconsistent with other studies suggesting that political ideology is a principal factor indicating support for climate-friendly policies (McCright et al., 2014; Bedsworth & Hanak, 2013; Guber, 2001). However, Campbell & Kay (2014) note that understanding the effect of ideology on climate related policies requires more than just knowing party affiliation. Furthermore, political culture varies from region to region and “underlying political culture is not definitive in explaining an outcome; rather, it is a contextual factor in understanding local coastal growth management

dynamics” (Beatley, 2009 p58). This suggests that ideology plays a role but is not sufficient to determine adaptive action.

## **Conclusion**

Climate change is a threat to many coastal communities, and a recurring issue of debate across municipal, county, and state lines. The study described in this article investigated the adaptive decision making of NC coastal officials and how knowledge, ideology, and threat motivate officials to take adaptive action.

From this study, we know that information or knowledge about climate change is not statistically associated with adaptive action. We know that political ideology is not the most important factor for coastal officials when they consider taking adaptive action. We know that perceived threat from climate change is a more significant factor for taking action than either knowledge or ideology. Additionally, coastal officials appear most concerned about water related impacts associated with climate change.

In addition to concerns about sea level rise and sea-side flooding, officials also expressed concern regarding potential flooding in the sound-side rivers and tributaries where many of the permanent residents of the coastal counties live. Potential changes in weather patterns causing heavy downpours resulting in agricultural flooding or damage to the lucrative housing industry are other threats to the coastal communities mentioned by the officials. Since officials were concerned about the frequency and intensity of precipitation, sea level rise, and flooding future research might explore differences in willingness to take adaptive action based on a particular threat instead of a general threat from climate change. Additional

refinements for future researchers would include asking officials to rank the threats to their community, as well as probing other issues related to water including quality and availability.

What we do not know is what, if any, effect increasing climate competence, public expertise, or even climate literacy might have in prompting adaptive action. Competence, expertise, and literacy are different from information or knowledge about climate change, and those differences have important distinctions. Developing public expertise would involve a re-alignment of the interaction between citizens, technical experts, and officials into something representing more of an equal partnership where decisions are made collaboratively (Kinsella, 2004). An official or member of the public that is conversant in the science of climate change would be in a better position to make decisions about adaptation than a person who merely possess a large quantity of information about climate change. Since public officials are members of the public before they become officials and while they serve as officials, this element of expertise is applicable here. By recognizing communities of officials, publics, and scientists, we create a system of understanding about climate change and the unique challenges that climate change presents to the coastal region of NC.

Climate literacy is an emerging field of interest among scholars and practitioners, and implies that a person has a sufficient understanding of both the drivers and impacts of climate change (US Global Change Research Program, 2009). Climate literacy is much more than being exposed to information or having knowledge of climate change, it entails an ability to synthesize and apply what you have learned to new or future situations. For example, someone can have knowledge

of the various systems in a house and have an impressive collection of operating manuals, but that does not mean that he or she is competent to conduct a home inspection. However, after years of home ownership one may be able to interpret a home inspection report written by a trained professional, and in that sense they are literate regarding home operations. In a similar sense, climate literacy becomes an intermediary step between an official possessing information or knowledge about climate change and being someone capable of making an informed adaptive decision.

Further underscoring the challenges of adaptation, a (2010) study of the Albemarle-Pamlico Estuary of eastern NC, The Nicholas Institute found that local officials most commonly called for additional funding and scientific information in their efforts to prepare for climate change. While an adequate resolution to the first challenge is not likely to occur anytime soon due to budgetary constraints, the Riggs et al., (2008) report regarding climate change on the NC coast clearly suggests that there is sufficient scientific evidence and information to begin taking adaptive action. The *lack of scientific information* the coastal officials mentioned in the 2010 Nicholas Institute study could be more indicative of the uncertainty embedded within climate change and how to adapt with scarce resources. A respondent in this study did mention that “A comprehensive education plan is needed to raise awareness and stimulate action.” However, my research and the literature suggest that more information alone, will not reduce the uncertainty nor will it solve the problem of insufficient adaptive action. Nevertheless, creating such a targeted education plan for coastal officials designed according to the climate literacy guidelines mentioned in the (2009) US Global Change Research Program would

serve as a good starting point on the long road to climate competence. Therefore, uniform consensus and resolution to the second challenge will remain an ongoing issue.

Many respondents in this study were quite skeptical about the threat of significant impacts from climate change, and about climate change science in general. For instance, one respondent commented that “there is significant skepticism locally of scientist’s projections”, while another official said, “global warming has been overhyped and found to be pseudoscience”, and still another official stated “I feel that climate change is being used as a byword in order to prompt social change, which probably is not a good idea.” Climate skepticism is not isolated to the coast of NC, yet these statements do raise interesting questions as to whether or not any new or additional information would change the minds of these officials. As long as coastal officials’ frame of reference remains the same—for instance, they do not believe in climate change, or frame it as a hoax or conspiracy—then it is entirely unclear that any information will change their attitudes or behaviors.

Other data from this study show survey respondents appeared knowledgeable about climate change, aware of the threat, and significantly motivated to act. One official said “Everyone seems to be too laid back or indifferent to preparing for the future”; another official mentioned a need to respond “on a regional level to pull together resources and act as a collective group”; while a third official talked about “developing a policy of adaptability.” Findings from this study suggest that, bridging the gap between the deniers and the believers will likely require researchers and practitioners to consider more than just knowledge, perceived threat, and political

ideology. The framing literature (Ascher, et al., 2010; Fischer, 2000; Schön & Rein, 1994) might provide insights regarding some of the leverage needed to foster adaptive action in light of the doubts, uncertainty, and skepticism.

Recalling the data from Table 2.9, presenting responses and frequencies of top threats from climate change, provides insight into what frames might be most effective with this specific population of coastal officials. Framing the need for climate change adaptive action through the lens of these top threats (frequency/intensity of precipitation, sea level rise, and flooding) could be more politically salient for this population of officials. However, we must be cautious and remember that the officials are not necessarily a unified, homogeneous group. Changing the frame of reference to the issues the local officials care about, as opposed to providing more general science, could be a more effective strategy for encouraging greater adaptive action. Interestingly, however, only two (2) respondents mentioned a need for accurate information about climate change, further driving home the point that additional information alone may not be the most direct path to adaptive action.

More broadly, much of what adaptation is about, whether in North Carolina or some other state, relates to finding new solutions to emerging problems (US EPA, 2014). However, innovation is often required to jump start those solutions, and implementing innovation within established institutions is not an easy task (Steelman, 2010). So it follows that just as a more holistic approach to coastal management and planning is necessary to foster coastal resiliency (Beatley, 2009), so too is a more holistic approach needed in terms of climate change adaptation research. In their (2013) research, Dupuis & Knoepfel documented the lack of

meaningfully robust climate change adaptation policies and the correspondingly weak implementation guidelines of those plans that do exist. Dupuis & Knoepfel's (2013) analysis suggests that the way climate change adaptation is framed matters in terms of the policy being tractable or not, and in terms of policy implementation. Adaptation is typically framed in one of three ways; as either climate change adaptation, climate variability adaptation, or vulnerability-centered adaptation (Dupuis & Knoepfel, 2013). Therefore, future research should explore if and how framing influences adaptive decision making. Ultimately part of what might be at play along the NC coast, and in climate change research and policy, is a struggle over the framing of climate change and the vulnerabilities associated with it (Moser 2009).

This study is not without its limitations. Officials from southern counties were slightly over represented in the sample. Not having an equal representation of northern-to-southern counties could have skewed the findings given that northern and southern counties face different threats based on differences in geomorphology (Riggs et al., 2008; NC Coastal Resources Commission, 2015), and begs the questions of whether coastal officials understand and incorporate geomorphology into their decision making routines or not. As noted earlier in the paper, respondents self-reported their political ideology, and though a majority of respondents self-reported as a moderate and a low number reported being liberal, we cannot conclude that these numbers are not representative of NC coastal officials. However, offering additional questions probing ideology and affiliation in future studies could better control for any such biased answering.

Coordination needs to improve among researchers and practitioners to address the multiple and complex challenges of climate change. Officials, coastal or non-coastal, do not carry the burden of adaptive decision making alone. Therefore, getting researchers and practitioners to move beyond their silos of disciplinary research, traditional analysis, and customary communication strategies would be a positive development for residents along the coast of NC.

## **FARMING THROUGH CHANGE: HOW SMALL FAMILY FARMERS BUILD RESILIENCE TO CLIMATE CHANGE THROUGH ADAPTIVE BEHAVIORS**

Climate change is projected to have a significant impact on both agricultural producers and agricultural production in the US (Easterling 1996; Walthal et al. 2012; IPCC 2014). When factoring in projected changes in increased mean temperature, models show crop production declining up to 10%; but under some high emission scenarios crop production may decline by as much as 63%, directly impacting gross farm sales (Walthal et al 2012). Differential vulnerability compounds these anticipated impacts by suggesting that climate change affects populations of people dissimilarly (Wisner, Blaikie, Cannon, & Davis 2010) and can be expected to apply to agricultural producers (IPCC 2014). Even though both large, nonfamily agricultural operations and small, family farms make significant contributions to the food system, the vulnerability and adaptive capacity of the two groups of farmers is not necessarily the same (Berry, Hogan, Ng, & Parkinson 2011) and therefore those differences are important to understand.

This study undertakes a phenomenological examination of a group of small family farmers in central North Carolina (NC) and investigates how they are experiencing climate change on their farms. This study asks the question, how are small family farmers in Chatham County, NC living with climate change? Only small family farms are under examination in this article. Through the use of photovoice, a community-based participatory research method, this study becomes diagnostic by looking at how macro changes associated with climate variability are impacting

individual small family farmers. The intentional use of participant derived data, including photographs and group discussions, helps us to begin to understand how small family farmers in Chatham County are adapting to changing conditions.

Farming is an important industry in North Carolina and has been for over 100 years. Chatham County is a typical farm county where the median size farm is 53 acres, very close to the state median of 51 acres (USDA 2012). In 2007, Chatham County ranked 13<sup>th</sup> out of the 100 counties in the state in terms of total market value of agricultural products sold, third in terms of the value of cattle and calves sold, and first in terms of sheep and goats (USDA 2007). These statistics belie the fact that much of the farming done in Chatham County occurs on small farms. A small family farm is one that earns less than \$350,000 in gross sales per year (Hoppe & MacDonald 2013). In 2007, there were 1,089 farms in Chatham County. The average farm in the county was just 96 acres, while over 400 of the farms in the county were between 10 and 49 acres. Production expenditures, on average, are higher for small, organic farms (\$171,978 versus \$109,359) than for all other types of farms, encompassing feed, repairs, maintenance, expenses for machinery, buildings, and land (USDA 2008). The average per farm production expenses for Chatham County in 2007 was \$127,701 though the average per farm net income for the same year was only \$33,335 (USDA 2007).

In 2013, due to dramatic increases in commodity prices and large-scale production contracts, the US Department of Agriculture (USDA) reclassified farms into four categories; small family, midsize family, large-scale family, and nonfamily farms, to reflect the changing landscape of farming in the US (Hoppe & MacDonald 2013). Large nonfamily farms primarily sell in commercial and overseas markets,

whereas the small family farms chiefly produce and sell goods for local markets (Hammond, Berardi, & Green 2013). Small family farmers are dedicated to growing healthy food, supporting local food systems, and fostering sustainable farming practices that contribute to overall ecosystem health (Berry et al. 2011; Hammond et al. 2013). Some of the more common sustainable farming practices include: maintaining buffer strips, using organic compost or mulch, using no-till or minimum-till techniques, maintaining beneficial insect or invertebrate habitat, planting crops to avoid cross-contamination, and use of beneficial organisms (USDA 2008). Adapting to climate change will be challenging for the large, nonfamily farming operations, but it stands to be significantly more daunting for small family farmers (Berry et al. 2011). Nonfamily farms typically have the ability to leverage greater capital and additional resources to withstand shocks to their operation. Small family farmers are less likely to have the capital, resources, or ability to withstand similar shocks to their operations (Hammond, et al. 2013; US Department of Agriculture 2007).

An estimated 91% of all farms in the U.S. are considered small, and 60% of all farms report less than \$10,000 in sales from agricultural products per year (USDA 2008). Because the impacts of climate change may affect small family farms more acutely and broadly than nonfamily farms (differential vulnerability), it is important to understand how small family farmers are experiencing climate change.

## **Background**

Many small family farmers across the country are interested in issues surrounding sustainable agriculture, ecosystem health, and food sovereignty (Jones,

Glenna, and Weltzien 2014). Conversely, large, nonfamily farms, and multi-national agricultural operations are more commonly centered on mechanized solutions to food security and bio-technical manipulation of crops and seeds (Jones et al. 2014). In this study, we situate small family farms in contrast to large nonfamily farms and other agricultural operations that trade in grain, seed, chemicals, fertilizers, or function as integral partners for supermarket chains or multi-national processors (Holt-Gimenez and Peabody 2008).

The division between those farms heavily invested in technical solutions, manipulation of the environment, in pursuit of market efficiency, and those following concepts grounded in sustainability, organic farming, and alternative solutions is well documented (Scott 1998; Holt-Gimenez 2008; Nicholas & Durham 2012; Brugger and Crimmins 2013). Scott (1998) characterizes these differences as the consequence of two agricultural logics; a “*logic of actual farming*” is one of an inventive, practiced response to highly variable environment, *the logic of scientific agriculture* is, by contrast, one of adapting the environment as much as possible to its centralizing and standardizing formulas” (301). This dichotomous contrast is based on a critical perspective that is grounded in fundamentally different ideological approaches to farming. Similarly, Brugger and Crimmins (2013) found two contrasting worldviews related to climate change among rural, agricultural communities in the southwestern US. The ontological perspective of one group of residents, including farmers, was labeled; “living with the climate” while the other group was labeled “overcoming the climate” (Brugger and Crimmins 2013 p1834). Where the first group saw man and nature united as one working symbiotically with the ecological system, the second group saw humans as separate and above nature

attempting to control the environment. The approach of these two groups is indicative of philosophical differences found at a macro-level regarding farming and agriculture. Beyond these noted conceptual differences, the empirical work of Nicholas and Durham (2012) found fundamental differences in the adaptive responses of farmers, grape growers and wineries in California. The adaptive responses of the farmers were characterized as either reactive or anticipatory, and individual or collective, while the adaptive capacity of smaller, family farms tended to be essentially different and on a much smaller scale than that of larger, more well-established or wealthy operations (Nicholas & Durham 2012). Nicholas and Durham also suggested that the responses not only reflected differences in capital but were intentional choices that aligned with their ontology and sense of place that meant working within existing conditions instead of manufacturing technical fixes for changing conditions. Importantly, researchers continue to document the differences in how small family farms and nonfamily farms approach farming, because the differences manifest through their means of production, goods produced, and values underpin their operational decisions (Holt-Gimenez and Peabody 2008).

Embedded within each of the examples above is a community with an underlying philosophy or approach to agriculture. Researchers conducting those studies were attempting to understand the logic, ontology, or adaptive experience of agricultural communities and that same goal is at the heart of this study. The word community can have multiple meanings stemming from different elements. It can be used to identify individuals based on geographic elements of place; it can highlight the relational elements of a group of people; or it can focus on political elements that unite an otherwise disparate group of people (Eng & Parker 1994). In this study,

community is used to express the relational element of community as it pertains to small family farmers.

### **Farming, Climate Change, and Photovoice**

Most studies tend to primarily focus on physical thresholds, production levels, and economic issues at the sector-level when exploring the effects of climate change on agriculture (Antle & Capalbo 2010). For instance, the USDA provides great detail tracking global changes in the climate and how those changes are currently impacting US agriculture, then projecting those effects on future production levels and export markets, as well as other macro-trends relating to the industry as a whole (USDA 2013). Easterling (1996) characterizes the potential impacts of climate change on US agriculture as manageable due to the development of economic adaptations and new agronomic strategies. Similarly, Howden et al. (2007) discuss the future of adaptation and agriculture in terms of realigning policy options within a risk management framework of market dynamics, and a need to integrate the decision making environment by mainstreaming mitigation and adaptation, income diversification, and new cropping systems. Adams, McCarl, and Mearns (2003) recommend caution when attempting to project future assessments about the effects of climate change on US agricultural production and economic activity. However, Adams et al. (2003) argue that spatial scale matters in terms of understanding that regional differences are likely to vary significantly, even if projections for the country as a whole are more favorable. While these and other studies like them (focusing on climate change impacts threatening agriculture as an industry) do indeed provide

key insights into comprehensive agricultural trends, as Adams et al. (2003) suggest, the story unfolding at the local level is likely to be much different.

Even though there is a wealth of research addressing climate change, in some ways there is a deficit of innovative, cross-disciplinary research exploring adaptation to climate change when compared to the work of those addressing mitigation and climate change modeling (Moser 2010). Climate modeling scenarios and crop simulation projections are areas of frequent interest to climate researchers. Palatnik and Roson (2012) outline two contrasting approaches to modeling, each with its own strengths and limitations. Computable General Equilibrium (CGE) models provide a broad, aggregate look at national and international market trends, offer multiple mitigation scenarios, and a wide array of climate options to choose from, while partial equilibrium (PE) models are designed for a narrow look at the projected effects of climate change on a select few agricultural goods (Palatnik & Roson 2012). Meanwhile, Reily et al. (2007) use two global general circulation (GCM) models to forecast the impact of climate change and increasing levels of carbon dioxide (CO<sub>2</sub>) on crop yields for US agriculture in 2030 and 2090. Reily et al. suggest that climate change may prove beneficial for US agricultural production by 2090 if the adaptations are smart, strategic, and timely although substantial regional differences in production are likely to occur, especially in the South. Challinor, Ewert, Arnold, Simelton, and Fraser (2009) note that ensemble computer simulations have the potential to increase the reliability of climate modeling exercises thus reducing uncertainty surrounding crop management decision making, and will therefore better inform broad national policy strategies. Just as computer modeling experts are developing new and powerful tools necessary to inform climate change policy

discussions, social scientists are experimenting with new methods and approaches capable of addressing climate change.

During the 1990s, photovoice emerged as a community-based participatory research (CBPR) method first used in rural China as a new way to explore women's rights issues (Wang & Burris 1994). Empowerment is a central focus of photovoice, and the method is largely grounded in the theoretical and applied work surrounding feminist theory, participatory documentary photography, and the literacy work of Paulo Freire in South America (Israel, Eng, Schulz, & Parker 2013).

Drawing on these scholarly roots, photovoice has traditionally attracted researchers exploring issues regarding public health, social justice, or environmental justice. For instance, Baker and Wang (2006) used photovoice to understand whether older Americans admitted to clinics experienced pain differently than those not admitted to clinics. Through the use of photovoice, Williams, Sheffiedl, and Knibb (2014) discovered how social networks and pets provided critical emotional support for women coping with polycystic ovary syndrome. Meanwhile, Dong, Wong, and Simon, (2014) saw a lack of institutional support and understanding for the needs of the aging Chinese population in Chicago, so they turned to photovoice to explore the specific health needs of this hard to reach population.

Other researchers have used photovoice to work beyond health related issues to examine elements of social justice. Powell (2014) studied community relations in a small college town, noting tension and differences in how temporary university residents and established neighborhood residents felt, behaved, and interacted in the college community. Tanjasiri, Lew, Kuratani, Wong, and Fu (2011) used photovoice to uncover the health disparities, environmental factors, and adverse impact of

tobacco use among Asian American and Pacific Islanders in Washington state and California.

Environmental justice concerns have also been addressed through photovoice. Masuda and Crabtree (2010) worked with a community of residents of inner-city neighborhoods in Vancouver, British Columbia, enabling them to reframe their lives in the inner city from one primarily associated with drug use, public disgust and fear to one of personal struggle and survival despite their despondent surroundings, violence, and lack of institutional support. Bell (2008) used photovoice in the coalfields of West Virginia to chronicle the pervasive effects of low social capital and feelings of powerlessness in rural mining communities. Spencer, Garratt, Hockman, Bryant, and Kohn-Wood (2010) worked with parents of children of color enrolled in Head Start programs to address the health implications of environmental hazards in Detroit.

The participatory research studies listed above share an important common element, they all selected photovoice as the appropriate research method. Additionally, photovoice studies all share an interest in emphasizing the need to shift power imbalances, promoting human dignity, and advocating for marginalized or otherwise underserved populations. Because of photovoice's ability to gather important data and document or shift narratives, the method is beginning to be used beyond the field of public health, environmental justice, or social justice studies.

A few researchers have used photovoice with farmers to focus on issues surrounding development pressure, discrimination, connections with the land, and transitioning as new farmers. In (2009) Gotschi, Delve, and Freyer incorporated participatory photography during their work with farmers in Mozambique to

understand their livelihoods, practices, and how the farmers were experiencing development pressure. The use of photographs and group discussions contributed to significant insights for the farmers in helping them to understand new ways to leverage their own social capital to address issues important to their community (Gotschi et al. 2009). Jones, Glenna, and Weltzien (2014) used photovoice with farmers in West Africa to study plant breeding options, noting how the method was tremendously valuable in shifting processes of communication and innovation, and in fostering outcomes that were empowering for farmers.

Researchers in North Carolina used photovoice to examine how African American farmers in eastern NC experience issues regarding land ownership and loss. In their study, Balvanz, Barlow, Lewis, Samuel, Owens, Parker, D Marco, Crowder, Williams, Barker, Lightfoot, and Ammerman (2011) leveraged photovoice in a domestic farming environment and discovered a community of resourceful and hopeful farmers who nevertheless faced real issues of discrimination, institutional isolation, and a lack of organized programs geared to creating a base of future African American farmers. In that particular study, photovoice was able to uncover how a history of discrimination and isolation had impacted a group of farmers across several generations. Ngo and Brklacich (2013) used photovoice to explore the experience of new farmers and their assimilation into the local food movement in rural Ontario. The new farmers in the study were found to be part of a larger system of change in the area that fundamentally altered the residents' sense of place, what it meant to be a farmer, and a trend of urban encroachment on the rural communities.

In still fewer instances, photovoice has been used with farmers concerning issues related to climate change. In those studies researchers tended to focus mostly

on perceptions of climate change. For instance, Baldwin and Chandler (2010) used photovoice to study community perceptions about climate change and sea-level rise in areas near the Noosa Biosphere Reserve, Australia. By separating the participants into groups of artists, residents, and visitors, the researchers found differences in how the three groups represented issues of concern and talked about solutions. Residents were more concerned in accurately describing how climate change was impacting the local area, whereas artists thought about visual representation of changes, and visitors were more concerned with the global impacts of climate change across society. Sherren and Verstraten (2013) used photo-elicitation, a research method very similar to photovoice, to study what maritime livestock farmers in Nova Scotia, Canada thought in terms of climate change being a threat to the surrounding wetlands. They found that the farmers did not associate images of the landscape and wetlands with concerns about climate change, but instead expressed concern about economic viability, ecosystem stewardship, and the wetlands as it relates to their sense of identity (Sherren & Verstraten 2013).

Smith Jr., Liu, Safi, and Chief (2014) also used photo elicitation to examine the attitude and perception of Native Americans in the southwestern US with those of local ranchers and farmers regarding climate change. Smith et al. (2014) found little support for the concept of climate change or other future-oriented sustainability policies among ranchers and farmers. Researchers there suggested a more effective strategy for addressing climate attitudes among rural groups, including farmers, instead of trying to provide additional educational information about climate change, would be to reduce the tendency of people to associate exclusively with like-minded individuals (homophily). Meanwhile, Beilin (2005)

worked with farmers in Australia to get a sense how they think of their community and the challenges they face farming. Beilin (2005) found the farmers considered themselves to be a group of land conservationists, managing changes in their farming practices while benefiting from a strong bond between their connection to the land, their values attached to that land, and the accompanying sense of place.

Despite the work of the previously mentioned researchers, there is a gap in the literature in terms of understanding how small family farmers are experiencing climate change *and* adapting to it. That gap becomes even larger when trying to identify researchers working across disciplines and using an innovative methodological approach. This research study employs photovoice to inductively help fill that gap of knowledge. Ultimately, the studies cited above provide an important service in demonstrating how a photography-based research method can be innovative and constructive in social science research, and provide valuable insight for practitioners and policy makers especially with regards to climate change.

Lopez, Eng, Robinson, and Wang (2013) noted there is great value in conducting research that involves the direct collaboration of the study participants. Beebe (1995) found similar value in working directly with community members stating, “The most important way of learning about conditions is to ask local participants what they know” (p45). Similarly, Eakin and Luers (2006) discussed the theoretical significance and applied importance of including the residents of potentially vulnerable groups in the evaluation process, if policy makers were to have meaningful assessments of that group’s likelihood of vulnerability.

Photovoice allows researchers to work collaboratively with a group of individuals to get an insider’s sense of the concerns and values of that particular

community (Israel et al. 2013). Because photovoice is “a process by which people can identify, represent, and enhance their community through a specific photographic technique” (Wang & Burris 1997 p369), it is a method appropriate for this research question-*how are small family farmers in Chatham County, NC experiencing climate change*. Furthermore, we agree with researchers (e.g., Wang & Burris 1994; Beebe 1995; Baker & Wang 2006; Bell 2008; Lopez, et al. 2013; Powell 2014) who embrace applying new research methods in the exploration of important issues, and by doing so create new opportunities for enhanced understanding. By adhering to the community-based participatory spirit of photovoice, we discovered and reveal the nuanced understanding and experience of small family farmers that is akin to the agricultural zeitgeist “living with the climate” (Brugger & Crimmins 2013 p1834).

## **Methods**

Data collection ran from July 2013 through December 2013. A total of six group meetings were held, including the first, which served as an orientation meeting. A single final meeting, number seven, was held with just one farmer who was unable to make a previous meeting due to an emergency. The meetings were designed to allow the participants to collectively discuss their photographs and any emerging themes from their photographs or from photographs from previous discussions. The group discussions were audiotaped and transcribed verbatim, with the permission of the participants. Frequently during the study, previous discussions or discoveries from the transcripts served as a conversation starting point and facilitated new discussions.

## ***Recruitment***

The population of interest in this study was defined as “small family farmers” in Chatham County, NC. Therefore, only small family farmers working in this particular county were eligible to participate in the project. Two local nonprofit organizations working directly with organic farmers served as entry points to the farming community in Chatham County. We assembled a database of 37 potential participant-farmers from the two organizations, while a community gate-keeper assisted in recruiting and facilitating the participation of the organic farming community. A notice was sent to all 37 potential participants inviting them to attend an information session. Nine farmers attended the information session. Two of the nine farmers declined to participate, (one for health reasons and the other due to the birth of a child), though both expressed interest in the study and the findings. To participate in the study, a farmer needed to meet the following criteria: they were a small family farmer in Chatham County; willing to take photographs about their farming experiences; open to sharing their photographs with the other farmers and the researcher; and able to commit to attending monthly group meetings for several months. Eventually seven farmers working across six separate farms agreed to participate in the study. One of the farms was run by a wife and husband team. Table 3.1 shows characteristics of the farmers and their farms.

Table 3.1 Characteristics of the participating farmers

	<b>Farmer A</b>	<b>Farmer B</b>	<b>Farmers C &amp; D</b>	<b>Farmer E</b>	<b>Farmer F</b>	<b>Farmer G</b>
<b>Years Farming</b>	42	4	5	<1	30	8
<b>Farming Acreage</b>	3 acres	2 acres set in 140	4 acres	0.5 acres	215 acres	4 acres
<b>Types of Crops</b>	Vegetable	Vegetable	Asian Heirloom, Herbs, Rice	Vegetable	Cattle & Hay	Fruit, Poultry, Vegetable
<b>Full or Part-time</b>	Full-time	Full-time	Full-time	Part-time	Part-time	Full-time
<b>Farming Methods</b>	Organic <sup>1</sup>	Organic <sup>1</sup>	Organic <sup>1</sup> Permaculture	Organic <sup>1</sup>	Hormone & Antibiotic free <sup>1</sup>	Organic <sup>2</sup>

Note: <sup>1</sup> = Not certified; <sup>2</sup> = Certified

As seen from the data in Table 3.1, the participating farmers have a considerably wide range of experience. For instance, Farmer E is a new farmer with less than one year of experience, though that farmer is renting a patch of land from one of NC's first certified organic farms. At the other end of the farming tenure scale are Farmers A and F. Both of these two farmers have farmed for more than three decades. Farmer A farmed full-time and was very active in the local community through training and other outreach practices. Farmer F was a cattle farmer and had been working the same land for 30 years so had good institutional knowledge about whether and how things were changing on his farm. Farmer B was also active in the local sustainable-agricultural community and freely offered assistance to fellow farmers. Farmer G had been farming for eight years, and works on a teaching farm and enjoys mentoring aspiring young organic farmers. Lastly, Farmers C and D are a wife and husband who had been farming for over five years, and were interested in expanding their permaculture practices as well as sharing their wisdom with farmers who were considering switching to permaculture. Although only one of the six farms is certified organic, each of the farmers farms organically. The decision to pursue the organic label is discussed in the findings section.

### ***Summary of the process and field work***

Once the seven farmers agreed to participate, an orientation meeting was held at which time the project was explained in greater detail. Participants completed Informed Consent documents as dictated by university protocol, and any remaining questions about the study were answered. New digital cameras and memory cards

were provided to the farmers at no expense to them. Participants also received training in the use of the digital cameras, and the ethics of taking photographs of people and group norms were discussed. The participants expressed enthusiasm for the project and several offered to host the group meetings, which made for a more personal and relaxing environment for them to share their thoughts.

During the first meeting (orientation session) the participants and the researcher jointly agreed on the first photo assignment to be completed prior to the next meeting. This assignment meant that the participants were to take photographs of any issues or concerns regarding climate change on their farm during the intervening weeks ahead of the next meeting. The subject of the photographs could be positively or negatively related to issues of climate change. Participants then brought their cameras to the next meeting so that the photographs could be uploaded to a password protected computer and catalogued according to the farmer who took the photographs and the date of the group meeting. Participants then collectively selected one photograph to serve as the starting point for the group discussion.

Throughout all of the meetings a standard protocol of SHOWED questions was followed. The photovoice group discussions were facilitated through a structured process and audio recordings were made for transcription and analysis. The photographs, group discussion notes and all other material related to the study were catalogued and stored on a password-protected computer. The group discussions followed a six-step inductive questioning process in line with the acronym SHOWED where each letter of SHOWED stands for a separate question posed to the group (Lopez et al. 2013). The six discussion questions are: what do you (S)ee in the

photograph; what is (*H*)appening in the photograph; how does this relate to (*O*ur lives; (*W*)hy do these issues exist; how can we become (*E*mpowered by our new social understanding; and what can we (*D*o to address these issues? The SHOWED discussion process originated from Paulo Freire's (1973) experimentation with praxis in South America, and is designed to foster empowerment among members of the participating community (Catalani et al. 2010). The SHOWED process created continuity from the first meeting to the last.

At the second meeting, the participants collectively discussed their photographs, what the pictures meant to them and why that particular issue was important to document in terms of their farms and climate change. The discussion at this meeting revolved largely around pests and invasive species. At the end of this meeting, the participants agreed that the issues regarding precipitation or rain should serve as the next photo assignment.

At the third meeting, participants again discussed the photographs they had taken since the last meeting, what those pictures meant to them, and why those particular issues were important in terms of their farms and climate change. At the end of this meeting several participants asked for flexibility in terms of the remaining photo assignments so that they would be free to take photographs of whatever occurred to them related to climate change and farming between meetings instead of being restricted to just one agreed upon topic. The participants and researcher jointly agreed to this change, suggesting that it might allow for greater flexibility and provide additional insight into the subject. Their suggestion marked an important evolution in the study and is faithful to the collaborative spirit of a photovoice project. The flexibility ultimately increased the ability of the farmers to

discuss how climate change is being experienced on their farms, their ability to talk about how they are “living with the climate” as described by Bruggers and Crimmins (2013), and the overall value of the study. Flexible photo assignments were used for the remaining meetings.

During the fourth, fifth, and sixth meetings, participants continued discussing their photographs pursuant to the SHOWED process as it related to their farms and climate change. One participant was unable to attend the sixth meeting, so an individual meeting was held three weeks later where the researcher and farmer walked the farm while talking about the previous meeting and photographs. That meeting was also audio recorded. Throughout the six months of data collection, the participants took a similar number of photographs (range = 22) for a total of 182 total photographs. For instance, if the farmer who took the most number of photographs took 52 photos then the farmer who took the least number of photographs took 30. Eleven hours of meeting time were recorded.

### ***Study area***

This study took place in Chatham County, NC. Chatham County is in central NC, located directly adjacent to Wake County, and near the cities of Raleigh, Durham, and Chapel Hill (Figure 3.1). Chatham County is a predominately rural county consisting of 682 square miles. The county is home to 66, 817 people, which equates to only 93 persons per square mile, considerably below the state average of 196 people (US Census 2014).



Figure 3.1 Map of NC with Chatham County highlighted  
Source: Wikipedia (2015)

Although Chatham County is predominantly rural, the county is doing much better than the state average in several key socio-demographic data shown in Table 3.2. The demographics of Chatham County are important because they provide additional context about the residents of this particular county, and since this county is doing better than the state average, it would be interesting for future researchers to compare responses from Chatham County to a county performing below the state averages. Chatham County is home to three regularly occurring farmers' markets serving a population hungry for locally grown, sustainable agricultural products. Chatham County contains a well-educated population, with good household income, a low level poverty, and a high rate of home ownership (Table 3.2).

Table 3.2 Chatham County demographics

<b>Attribute</b>	<b>Chatham County</b>	<b>State of North Carolina</b>	<b>(+/-) State average</b>
Median HH income	\$57,793	\$46,450	+12,343
Persons below Poverty Level	11.1%	16.8%	+5.7%
Bachelor's Degree or higher	36.7%	26.8%	+9.9%
Home ownership rate	80.4%	67.1%	+13.3%

Source: U.S. Census Quick Facts (2014)

### ***Data processing and analysis***

An iterative process of data collection and analysis was used throughout the study whereby constant assessment of emerging themes and issues were cross-checked with the group for accuracy (Lopez et al. 2013). Following the last of the discussions with the farmers, the transcripts were uploaded to Atlas.ti (7.1) for analysis. Thematic data coding and analysis followed a six step process as outlined by Braun and Clarke (2006): data familiarization, creation of initial codes, look for emerging themes, define and refine themes, and generate reports. A goal of inductive analysis is to get the researcher immersed in the data to discover themes and concepts embedded in the data instead of approaching the data with preconceived themes, categories, or theories about the data (Thomas 2006). This ground-up approach to data analysis was used during the entirety of the project whereby we would continuously read and reread the transcripts, code the existing data while still collecting additional data then organize, consolidate, and reinterpret or realign the

findings to the data (Ulin, Robinson, & Tolley 2005). A copy of the inductive coding instrument is included in Appendix C.

Themes and coding of the transcripts were tested with two external coders for reliability and consistency in coding. Based on the feedback of the external coders, one sub-code was eliminated due to duplication of concepts and another two sub-codes were clarified further enhancing the expression of the participants. Inter-coder reliability analysis for the three coders was kappa = .78.

## **Findings from the Farmers**

Analysis of the data revealed three primary categories pertaining to climate change and small family farming in Chatham County, NC. One category recounted observed changes that are happening at the farm-level, a second category presented new adaptive behaviors, and a third category about resilience behaviors taken by the farmers. The categories and sub-themes are presented in Table 3.3. Throughout the study, this group of small family farmers was confident that changes in the climate were occurring, and that changes were occurring on their farms. Farmer C suggested that locals shopping at the farmers market were also tuned into climate change saying, “*They know the weather is messed up.*” However, the farmers clearly did not feel that each and every change that they were experiencing was attributable to climate change. Additionally, the farmers expressed an understanding of the differences between weather and climate, and were careful not to conflate the two. The next few sections address themes from Table 3.3 as they relate to climate change and small family farming in central NC.

Table 3.3 Summary of observed changes, adaptive behavior and resilience behavior

<b>Observed Changes</b>
<ul style="list-style-type: none"> <li>• Changes in Rainfall &amp; Temperature</li> <li>• Pests &amp; Invasive Species</li> </ul>
<b>New Adaptive Behaviors</b>
<ul style="list-style-type: none"> <li>• Polyculture</li> <li>• Agrivoltism</li> <li>• Reflective cloth and hoop house</li> <li>• Seeds: saving, sharing, and banking</li> <li>• Crops and succession planting</li> <li>• Organic label</li> </ul>
<b>Resilience Behaviors</b>
<ul style="list-style-type: none"> <li>• Embracing existing resilience</li> <li>• Balancing family with multiple roles and skills</li> <li>• Continue building on Community connections</li> </ul>

### ***Observed changes***

#### *Rainfall and temperature*

The farmers noted how changes in both rainfall patterns and temperature fluctuations represent two areas of potential vulnerability for their crops and farms. During the months of June and July of 2013, Chatham County received nearly 200% of the normal precipitation for those two months. Parts of the county received more than five inches of rain in just one day (June 30<sup>th</sup>) causing major flooding. According to NOAA (2013), July of 2013 was the wettest since 1916 with 9.53 inches of rain. Farmer A took Figure 3.2 documenting damage following the abnormally heavy

period of rain and reported a fence being knocked down by storm water runoff and debris.



Figure 3.2 Damage from heavy precipitation

Regarding the unusually heavy rainfall, Farmer A, who has been farming for four decades, said “*That had to be the biggest, concentrated rain we've ever had. That fence has been there for decades. Seven inches of rain in 14 hours! It knocked down the fence and allowed deer to run in and take up residence. We've had a lot of damage.*” Following the downing of the fence, the farmer had to coordinate with local wildlife officials who needed to issue emergency hunting permits prior to removing the deer from the farm; all of which took some time and extended the chances of additional damage being done to the crops.

The farmers also mentioned how variability in temperature patterns, either extreme heat or unexpectedly colder weather, is presenting problems for them. Farmer F was beginning to make strategic decisions about what time of day to do chores on the farm and felt “like a prisoner on my farm” in some ways due to the

temperature changes, precipitation extremes, and presence of pests. Several other farmers reported planting crops much later than they normally would have due to the colder than normal temperatures during much of the spring and summer. The fluctuations in planting schedules and climate conditions prevented some summer crops, such as sweet potatoes and peppers in particular, from fully maturing and negatively impacting sales.

### *Pests and invasive species*

When discussing invasive species, Farmer B took Figure 3.3 and noted how “*there’s mysterious stuff going on, like out of season stuff. It seemed like the fire ants came earlier and heavier than usual.*” Similarly, Farmer F stated “*if this increase in invasive species is in any way related to climate change then I’m definitely suffering because it’s the thing I spend the most time on.*” Managing the pressure of pests and invasive species can be difficult for the farmers intent on adhering to tenets of organic farming that eschew the use of pesticides, and is one example of the differential impacts of climate change on this population of farmers. Farmer B noted “*the pest pressure is pretty intense right now especially if your market is waiting for kale, you can’t afford to not do anything.*”



Figure 3.3 Fire ants

According to the farmers, the overall effects of biting insects and fire ants is a problem and climate change seems to be facilitating the spread of ticks, mosquitos, and other bugs. In contrast, the emergence of some invasive species, Japanese stiltgrass, for instance can have limited positive effects.

Over the past several years, one farmer was seeing Japanese stiltgrass (*microstegium vimineum*) spread across the farm, see Figure 3.4. This invasive species has shown up all across several pastures threatening to choke the grass needed to feed a herd of cattle. The presence of this invasive species was a bit unsettling because the farmer was unsure at first how to contain the stiltgrass and how it would impact the animals and farm.



Figure 3.4 Microstegium vimineum

However, much to the farmer's surprise the cattle developed a taste for the stiltgrass and are doing a good job of managing its spread. Figure 3.5 taken by Farmer F, was double-coded for resilience and invasive species. In this instance, the farmers talked about how invasive species were amplifying their need as farmers for resilience, and how animals were responding to invasive species-sometimes in surprising ways. Farmer F stated, "*It's a case of the animals adapting to the environment before my eyes. That resilience and insistence is what we're going to need to have going forward.*"



Figure 3.5 Cow eating microstegium

This discussion about the stiltgrass emerged as an example of how the farmers were “living with the climate” akin to the ontology mentioned by Brugger and Crimmins (2013). This farmer chose not to consider the emergence of Japanese stiltgrass as something to be immediately eradicated through the aggressive treatment of pesticides, but instead was pleasantly surprised to see how the cattle were doing a good job of managing the spread of the stiltgrass naturally.

Through the collective 90 years of farming between them, these small family farmers were chronicling changes that directly threaten both the short term and long term sustainability of their profession. The observed changes in temperature and precipitation patterns and the presence of pests and invasive species not only represent vulnerabilities to the business side of their farming practices, but also vulnerabilities to a way of life deeply embedded within the county and the

accompanying cultural significance that has grown through the decades from being a small family farmer in North Carolina.

### ***New adaptive behaviors***

The farmers are experimenting with a variety of adaptive strategies including some innovative practices along with more traditional approaches to combat climate change. Farmer A has been especially innovative in regard to two adaptive strategies and documented those efforts in Figures 3.6 and 3.7.

### *Diversity in the field*

One of the new or more innovative strategies is polyculture. The practice of polyculture takes into account a number of different considerations including the height, footprint, light, water and nutrient requirements of several crops in order to use the trees and plants as facilitator-protectors of neighboring plants. On this farm, polyculture involves the strategic positioning of a variety of crops to grow and intermingle in the shadow of a black walnut tree and the naturally occurring shade as seen in Figure 3.6. Polyculture requires the farmer to work with the climate and the requirements of several plants in the same location on the farm. Farmer A mentioned the polyculture experiment he began stating, “*I'm testing, using different shade from trees that are going to lose their leaves soon...right now we are doing one experiment with okra, beets, spinach, lettuce, and cilantro.*”



Figure 3.6 Polyculture

#### *Innovation in the field*

Another new adaptive strategy is agrivoltism. Agrivoltism is a similar strategy to polyculture, but involves the manipulation of solar panels to maximize sun and shade throughout the day to the times when the plants situated below the panels can make the most use of the warmth and shade. An example of agrivoltism is seen in Figure 3.7.

Agrivoltism was first proposed by Goetzberger and Zastrow (1982) as a way to leverage the production of solar energy and plant cultivation in the same space by elevating solar panels above rows of crops to maximize sun and shade cycles.



Figure 3.7 Agrivoltism

Agrivoltism as an adaptive strategy is an ongoing experiment requiring adjustment throughout the growing season, depending on the angle of the sun, and the crops the farmer is working. Farmer A explained their current efforts, “*We are learning how to use the shade from the solar panels...it warms up in the morning when it's useful to the plant to be warmed up, and then it's protected later in the day when it's useful for it to be in the shade.*”

#### *Traditional strategies*

Managing variability in terms of temperature and precipitation are constant challenges for the farmers, causing some to consider purchasing reflective cloth or building hoop houses for protection to limit or control the temperature and precipitation exposure of the plants. However, the reflective cloth can be exceptionally expensive often requiring the completion of a grant application, which

can reduce their time in the field and necessitate a particular style of writing for favorable grant approval. Hoop houses are usually a light weight, scaled-down version of a greenhouse that can extend the growing season by providing protection from predators and the weather. Hoop houses can be a good alternative if the farmer has the necessary resources to assemble the structure and replace the plastic when it eventually becomes damaged. Additionally, once a hoop house is constructed the farmer needs to carefully monitor the soil for excessive salinity buildup, or have the available manpower to remove and replace the protective barrier at frequent intervals to allow the rain to naturally penetrate and flush through the soil. Because the Chatham County farmers stated that they experienced unusual variability in temperatures during 2013, they felt the need to take adaptive action to these changes in the form of reflective cloth and hoop houses.

### *Collective strategies*

The farmers talked about organizing a local seed bank and seed sharing program as a step toward increased resilience. Farmer B said, “*It'd be really neat to have something like that in this town.*” The farmers went so far as to talk about getting the equipment, dedicating space in a particular building for the first freezer, and asking for the input of anyone familiar with the efforts of the Federal Seed Bank in New York and how information about that seed bank could be leveraged in Chatham County. Setting up a seed bank would allow the farmers an additional opportunity to share knowledge about what is working in the county and in fostering resiliency across the farms. A seed bank would serve as an adaptive behavior against the variability in temperature and precipitation patterns, invasive species and pests

that the farmers are seeing on their farms. By establishing a central locale in the community where small family farmers could share and store seed varieties that are doing well in the changing climate that they are seeing, the farmers adapt and leverage their site-specific knowledge about what plants work well and which ones are not responding to the variability. The focus group meetings provided a forum that allowed the farmers the opportunity for the idea to emerge and be discussed as something the community desires instead of the idea languishing as merely a good idea that was not explored further.

### *Sequence strategies*

Succession planting is another adaptive strategy used by several of the farmers. Typically in this adaptive behavior the farmers either stagger planting the same crop at specific timed intervals to have a continuous harvest, or they quickly rotate different crops into the same growing space once one crop is harvested.

Farmer B used both strategies and said, “*Succession planting is working well.*” Farmer D used the interval method and noted how “*we were pulling 200 pounds a week off of them for over a month and it only went below 60 or 70 pounds about a week ago...it was incredible. Too much!*” Farmer G plans to use both methods and commented, “*We’re going to do more succession planting of cucumbers to extend the season...we’re going to do different regional varieties.*”

Farmer C reiterated the value of being flexible and of succession crops stating, “*If you set up your farm with all these perennials that are based on how perennials have performed in the past year, so you put in all your blueberries and fruit trees and everything and then the climate changes here and all that stuff fails, then what*

*are you left with? You have nothing.*" Succession planting is already working for a few of these farmers, while those that are not currently doing so are hearing firsthand how this adaptive behavior is providing plenty of produce and a bit of insurance against the changing climate that they are experiencing.

The farmers are adapting to the changes and variability associated with the emerging new normal of climate change. As already mentioned, June 2013 was the third wettest June on record since 1900, with 7.83 inches of rain. The exceptionally wet conditions allowed Farmers C and D to establish a field of rice (Figure 3.8), without the normal concern and expense of watering the field. According to Farmer C, "*This year we grew rice in the Piedmont with really no irrigation at all. We've been trying to grow rice for a while now with varied success, but we've always had to flood from our pond in the beginning just to get going. This year we didn't need it.*" Even though Farmers C and D benefited from the extreme precipitation with a bountiful crop of rice, the wet conditions hampered their efforts with other crops. While speaking about climate variability and extremes, the seven farmers did not make ambivalent generalizations about climate change or say that climate change was necessarily a benign development.



Figure 3.8 Rice field

Part of the larger message about adapting to change and fostering resilience was summed up by Farmer G “*I think you have to step back and say it's out of my control. I think it teaches us, for me anyway, you have to let go. You can't just hold on.*” The message from the farmers here is not resignation in the face of insurmountable change, but an acknowledgment and embracement of change.

#### *Recognition strategies*

The question about whether the farmers chose to pursue the certified organic label or not spoke to their connection with community and was brought up during a group meeting. Recalling the demographic data from Table 3.1, although Farmer G is the only farmer designated as certified organic, all of the farmers were adamant that they adhere to organic farming practices. All of the famers said that the criteria and certification process of the organic labeling program is burdensome, expensive, and not necessary for many of them or other farmers they know. Farmer E said, “*If*

*you're able to see the farmer, actually talk to them, you're at the Farmer's Market or Community Supported Agriculture (CSA), or you see them every week or something, you get to know them. You get to know their practices, and I think it's all about trust.*" The farmers said that new customers routinely ask at the local farmers market whether their products are organic or not, but according to Farmer D "*We've never had a customer, or a restaurant, or anybody deny buying from us because we weren't certified organic. It's never happened, so there doesn't seem to be any point in doing it.*" The organic label decision is important because it demonstrates the resilience of the connection between the farmers and the local community. In the context of climate change, if that bond were not as strong as it is, then the farmers might reconsider the organic certification process.

The farmers report that the weekly markets where they sell their goods are an ideal place for them to explain their organic practices, listen and learn from their fellow farmers, and build strong connections with the community. Ultimately, "*if the only contact you have with the product is the label on the package, then, yeah, we absolutely need organic labels*" according to Farmer E. Additionally, with small profit margins and established relationships with many people and businesses in the community, there is little incentive for these small family farmers to pay to pursue the organic certification label. The fact that these small family farmers do not need to pursue the organic certification is indicative of the healthy relationship the farmers have with their local community. Furthermore, the resilience of their organic practices and the crops they grow is affirmed by the sale of their goods throughout the county.

The new adaptive behaviors, such as polyculture and agrivoltism, represent the exercised application of the farmers' knowledge and intuition of ways to respond to a changing climate in Chatham County. Moreover, the observed changes, such as variability in temperature and precipitation, or the presence of pests and invasive species, and the corresponding adaptive behaviors signify a community of people that are living with a changing climate and who are committed to finding resilient strategies that work within their philosophy of farming.

### **Resilience behaviors**

Given the observed changes that the farmers have noted and the projected changes to come in the near and distant future, the farmers are wise to leverage their existing strengths and resources to bolster their resilience. The farmers repeatedly mentioned family and community as their most reliable and powerful sources of support capable of assisting them to face the challenges of being a small family farmer living with climate change.

### *Valuing biotic resilience*

Figure 3.9, taken by Farmer D, is an example of how these small family farmers see themselves and represents them being in tune with this ontological perspective. The farmers talked about how this tomato plant embodied the resiliency needed to adapt to the changing climate. Farmer D, who took the photograph, mentioned how "*It was symbolic to resilience and adaptability to climate change, and we need to be like that. We can't expect the plant to perform in July and August. Maybe we need to plant all year round.*" Farmer G concurred and added to

the discussion about resilience and the vulnerability to climate change saying, “*shouldn’t the bigger conversation include creating resilient ecosystems and perennial ecosystems, so that when we do get this condition (climate change) that something is going to thrive?*” Additionally, Farmer G went on to say, resilience as a small farm means “*keeping an open mind and not getting locked into one thing...its about nonattachment.*”



Figure 3.9 Tomato plant

As further evidence of their awareness of changing conditions and their efforts to work with the changing climate, Farmer G talked about how well a naturally seeded in amaranth plant (Figure 3.10) was growing compared to how poorly the corn they planted and was doing. The farmer felt the amaranth plant was symbolic of the need for personal and societal reflection and flexibility in the face of a changing climate. By listing off six different functions of this one amaranth plant, Farmer G said, “*it was a pretty potent example of ‘what do we need’ and ‘what do we want’*

*and how can we reconcile those differences and how can we adjust our expectations and our points of reliance on certain things in order to always have what we need.”*

Over the course of the study, the farmer took additional pictures (Figure 3.11) of the healthy, “*volunteer plant*” and in many ways the plant came to serve as a reminder about larger systems at work stating there is a “*need to broaden your awareness.*”

All of the farmers understood this amaranth plant to be a “volunteer” in that it was not intentionally planted in the middle of the walkway, but instead grew there because the seeds were either dropped by birds or blown by the wind.



Figure 3.10 Young Amaranth



Figure 3.11 Amaranth three weeks later

Awareness and adapting to changes were important issues for the small farmers. As someone who has farmed for thirty years Farmer F, said, “*The pace of change is accelerating. I just feel like we’re doing a lot more adjusting now than we have in my lifetime.*”

#### *Intrapersonal resilience*

The farmers also talked about how being a small family farmer meant regularly having to learn a number of separate professional skills external to farming, along with the more obvious challenges of managing capital, whether that meant finding the necessary equipment or money. The famers talked quite openly about decisions involving sacrifices pertaining to family and friends. Farmer E said you “*have to deal with sacrificing large potential components of your life in order to be a farmer.*” The farmers also mentioned having discussions and making decisions with their partners about whether to have children or not, indicating that

*“there are some substantial sacrifices that people make...and a lot of farmers just do not have children because of the financial vulnerability of farming”* according to Farmer F.

Small family farmers face additional financial challenges as well which often involve repairing or replacing material and equipment needed on the farm. For instance, managing the necessary repairs can involve bartering for services or making do with resources at hand. Farmers C and D barter with local entrepreneurs for services. Simply repairing equipment can be challenging, prompting Farmer G to state a typical repair process “*reminds me of that scene in the movie Apollo 13 when they dump the boxes on the table trying to fix things.*”

The farmers are fundamentally resilient as individuals and as a community. The fact that they are resilient is serving them and the community well in the context of climate change. The challenges that the farmers face should not be construed as evidence that the farmers see themselves as martyrs or somehow laboring under unreasonable circumstances. On the contrary, these farmers fully embrace their livelihood and the accompanying choices they make, and do so in a very straightforward and joyful manner. Farmer D spoke reflectively about the challenges of their chosen livelihood saying,

*When the times are good, it doesn’t mean that you’re rich and the car is running and everything is on time. Things are good when you walk in on your own two legs, you’ve got all of your digits, nothing is wrong with you...so knowing you’re always kind of walking that line...just knowing that we’re that fragile, because we are, is profound. And a lot of people don’t want to see it, or are able to see it, or have gotten away from it...but we see it everyday. It doesn’t make us any less feeling, but it makes us more appreciative.*

Additionally the farmers mentioned having to learn a multitude of skills in order to farm. While Farmer G talked about how “*A farmer is not somebody that just grows food. You have to be an accountant, marketer, public relations person, mechanic, or know how to do carpentry.*” Small family farmers face these and many other challenges on a daily basis, but according to them the challenges make them stronger and more appreciative. These resilient behaviors aid the famers in managing the countless and continuous ways that they need to respond to the observed changes for them to continue being small family farmers who stick to their farming philosophy.

### *Interpersonal resilience*

Community is a central component of being a small family farmer, and these farmers talked about community as a two-way system. The local community offers valuable moral, monetary, and logistical support to the farmers, while the farmers offer valuable support to the community through their careful production of agricultural goods. The farmers talked at length about the reciprocating nature of their relationship with the community. The farmers enjoy sharing their knowledge and experience with organic farming, while the community supports those efforts and benefits by having locally produced organic goods-ultimately both benefit and the local community grows stronger. The relationship with the local community is built and sustained on trust, and that trust and support manifests itself in times of trouble. For instance, Farmer A mentioned how the community rallied to support several farmers following a severe hailstorm about six years ago through donations, temporary labor, and as customers who intentionally sought out their goods immediately following the storm suggesting, “*the community can be your*

*insurance.*" Given that climate change is projected to substantially alter the frequency and intensity of precipitation patterns (Walthal et al. 2012), having a supportive local community enhances the resilience of these small family farmers.

When participants were asked the question, *Why do you farm?*, not only did the farmers speak of the risk and rewards of farming, but they also spoke of farming as an intuitive and creative act that connected them to something larger than themselves. It was quite evident that the farmers felt compelled to farm and that no other profession would suffice. Farmer A said, "*I've been doing this for forty years, I guess for me it's a creative act. Every moment while I'm out there, I'm creating something that's going to nourish other people*". While Farmer B said, "*I farm because I love feeling like I contribute to the well-being of my community by providing good, healthy food that is grown without chemicals and is delivered to our customers locally without having travelled thousands of miles.*"

Further illustrating the power and positive influence of the community, Farmer C talked about the strength and support of the local community for small family farmers in Chatham County. For instance, he commented that during their attempt several years ago to get their rice field established, "*We had a crop mob come out and help build the rice paddies and we've been growing it naturally there since.*"

When it comes to educating the local community about their sustainable agricultural practices and outreach efforts, Farmer B said "*We want to form a food network to stay in touch with all stakeholders in our local food system and advocate for policy choices that might be needed to support a strong food system in Chatham County.*"

All of these challenges and behaviors contribute directly to the increased resilience of these small family farmers. Furthermore, the resilient behaviors of the farmers, such as developing new on-farm skills, actively re-balancing family needs and decisions, and expanding their connections with the community, begin to touch on what Clark (2002) called integrative solutions, or solutions that rely on an creating an entirely new framework and perspective for managing changing or difficult conditions.

## **Reflections and Study Limitations**

This research explored the impact of climate change on the livelihood of small family farmers from the participants' perspective. Through the participatory methodology of photovoice, participants were able to shed light on how they are experiencing vulnerability to climate change. Findings from this study illustrate the symbiotic relationship between the farmers and the community. These small family farmers are fostering a strong sense of community through the careful cultivation of their crops yet at the same time are relying on the local community to support their livelihood.

A purposive sample was used in this study, and as with most studies using a purposive sample, it is natural to expect questions of selection bias and generalizability. However, we began this study aware of those common concerns but suggested that intentionally selecting for only small family farmers and the choice of photovoice to explore climate change in central NC largely outweighed any issues regarding generalizability. Using photovoice presents challenges for researchers and participants, and doing so with farmers was no exception. A familiar refrain from

researchers using photovoice (Baker & Wang 2006) is varying degrees of participation in both the photo assignments and the all-important focus group discussions. The participants were extremely busy people doing labor-intensive work for long hours in often difficult conditions. Asking farmers to keep the photo assignments in the front of their minds and cameras in their pocket was a lot to ask. Therefore it is entirely expected that some farmers took more pictures than others (though all took more than 20 photos) and that it was not possible for every farmer to attend every group meeting, especially if something more pressing needed to be done on the farm. The perception of a small number of participants actually represents considerable time and effort on the part of the collaborator-participant. In their review of 37 peer reviewed photovoice articles, Catalani and Minkler (2010) discovered a wide range in the number of study participants across a series of photovoice projects from a low of four participants in one study to a maximum of 122 people in another study, while the median project size was 13 participants. Furthermore, Catalani and Minkler (2010) found no relationship between the number of participants and quality. Based on their (2010) findings the sample size of seven farmers is reasonable for a study of this nature. The farmers in this study were representative of the sustainable-agricultural community in Chatham County farming where 93% of all farms are operated by a family or individual (City Data 2013). Importantly, Lopez and et al. (2013) note the value and intent of research using photo elicitation or photovoice is to deeply explore an issue of importance to a community as opposed to being overly concerned with creating broadly generalizable findings.

## **Discussion and Conclusion**

The aim of this study was to begin to understand how small family farmers in central North Carolina were experiencing a changing climate. Results indicated that these farmers are working to ensure the viability of small family farming through their adaptive behaviors and reliance on community support in response to changes they are experiencing on their farms. Because the farmers are incorporating succession planting strategies, taking steps to create a seed bank to save and share seeds, and introducing polyculture practices in the fields, they are finding ways to farm with the changes they are experiencing. Additionally, the farmers are finding ways to farm with the changes through physical or structural adjustments such as building hoop houses, hanging reflective cloth, or strategically planting crops under photovoltaic panels (agrivoltism) creating co-benefits from the use of space in the fields.

Through the convergence of these three types of resilience, these small family farmers are fostering the long-term viability of the livelihood that they see as a creative act. Furthermore, their close connection with the local community represents not only a powerful resource capable of supporting them but is also an important responsibility that must be continuously earned through their careful stewardship of the local ecosystem. The fact that these small family farmers do not need the organic certification is a testament to the health of the farmer-community relationship. Functionally, this study provided a structured forum for the farmers to gather on a recurring basis allowing them to meet likeminded farmers that they may not have previously known along with an opportunity to discuss climate change—an issue of importance to them and many others in the local community. Through the

structured discussions and unstructured interactions during this study, the farmers began developing plans for a seed bank whereby they can save and share seeds that are thriving on their farms. The farmers mentioned that the seed bank could serve as an additional hub of interaction and information sharing, similar to the weekly farmers market, not only for themselves but for the local gardeners who might be interested in learning more from the farmers.

As a result of this research, an important and additional gradient of understanding has been created in terms of the collective knowledge of how climate change is impacting farming. Furthermore, the findings offer policy makers and practitioners valuable insight into how this group of small family farmers is adapting to climate change in North Carolina that can be leveraged in future policy directives. A summary of relevant findings discussed below are examples of place-specific experiences that could inform such policy considerations.

Small family farmers in Chatham County are noticing unusual variability especially in the frequency and intensity of rainfall, abnormally low temperatures, and in shifting growing schedules. Such unpredictable fluctuations can stretch the resources of small family farmers (Berry et al. 2011). However, these small family farmers are continually showing their ability to adapt and find new ways to increase their resilience through their experiments with polyculture and agrivoltism for instance. This flexible and intuitive, situation-specific knowledge that the farmers are engaged in is akin to the Greek concept of *mētis*. Scott (1998) characterizes *mētis* as an ineffable skill that is learned through place-based experience, intuition, learned sense of timing, and awareness. These small family farmers demonstrated how they are relying on their learned experiences within the county, showing flexibility in

making decisions about crops and planting schedules, trusting their intuition, and applying their place-based practical knowledge to the ever-changing conditions on their farms.

Scott (1998) suggests that there is great social value and wisdom in mētis, and just because it is an alternative way of knowing, which is more of a lived knowledge, that does not lend itself to be written down and passed along like more traditional material does not mean that it should not be trusted or implemented. In fact, Scott (1998) contrasts the strength and durability of polyculture in fostering diversity and resilience to the standardization and technical efficiency associated with high-modern agricultural practices. The mētis Scott discusses as an alternative orientation in farming is a practice that rings true with the practices seen across the farms of Chatham County.

In many ways these farmers are important exemplars for similar efforts being played out all across the country. These farmers are representative other small groups of people with a strong connection to the land and with a keen sense of place who are attempting to maintain a sense of community and connection to healthy, sustainable practices in the face of a changing, highly variable climate, and pressure from development. The farmers are exercising a similar worldview to the 'living with the climate' ontology noted by Bruggers and Crimmins (2013) through their communal spirit and community support, dedication to organic practices, remarks about being connected within a larger natural ecosystem, and their adaptive and resilient strategies. In understanding that they are part of a larger system that is changing, the small family farmers embraced the changing climate and found ways through polyculture, agrivoltism, succession planting, hoop houses, reflective cloth,

and in maintaining a close relationship with the community to show their resilience. Importantly, the farmers are able to stay true to their philosophy of farming and increase their resilience instead of changing their philosophy of farming because of climate change. Having this worldview creates a nature-society mutuality among the farmers that encourages and emphasizes the inclusion of situated knowledge over more technical orientations (Bruggers & Crimmins 2013). The farmers are much more than producers of agricultural products, they are practitioners and teachers, demonstrating how to live through a different connection to the land and a healthy food system.

In terms of building a sustainable agricultural movement beyond the local community, Farmer B said, “*I don’t want to use the word war, but we’re in this sort of battle. This ideological battle with people who don’t get why there’s sustainable organic locally grown food.*” The sentiment from this quote rings true with Scott’s (1998) implication that there are two general movements in agriculture, one focused on fertilizer (non family farms) and the other focused on fertility (small family farms). Furthermore, the farmers talked about the need to continue emphasizing education and advocating for sustainable agriculture, noting the value of the practices extends far beyond the goods produced. According to Farmer C “*we love doing this and we saw what was happening to the food system worldwide, but especially in this country. How it’s getting taken over by big agriculture and corporate NGOs. We wanted to be part of the solution.*”

Farmer G sees opportunities for the community of small family farmers in Chatham County stating: “*Climate change isn’t all that bad. It is teaching us to go back to our gut. You can’t just follow a textbook anymore. You’ve got to be*

*observant. You've got to be tuned in. You can't just be like, "OK, it's April, so I'm going to do this." We've got to talk. It is good. It's bringing back community. It's bringing back our connection with nature so it's not all bad."*

What we have learned from this study is that these small family famers are experiencing change on their farms and are passionate about maintaining their sustainable agricultural practices. The farmers are committed to enhancing the well-being of the community, educating and advocating for sustainable agricultural practices, as well as continuing to find new adaptive responses to climate change. With respect to maintaining their ability to farm, Farmer D said “*You're going to lose some stuff but then if you have enough variety in your production you're going to find stuff that does well and just be able to adapt every season and know that every season will be different.*” This study serves as both an innovative step in the short term, and as a valuable starting point in the long run for understanding how small family farmers adapt to climate change. Importantly, this study is probably one of the first few instances of photovoice being used in the US to explicitly study how small family farmers are experiencing climate change. In contrast to the work of Balvanez et al. (2011) who focused on NC farmers but not in terms of climate change, Ngo and Brklacich (2013) who focused on new farmers and their sense of place, or Baldwin and Chandler (2010) who focused on sea level rise at an arts festival, this research examined climate change through the experience of small family farmers. Moreover, this study extends the application of photovoice as a practical tool for researchers to explore new areas of inquiry important to them, and opened up the conversation about seed banking In the long term, this study of the commonplace experiences of small family farmers in central NC could serve one of the building

blocks for a body of literature that becomes generalizable about small family farmers facing climate change.

James Scott's ethnographic work with peasant farmers in Malaysia chronicled their experiences, challenges, and class conflict during a time of rapid transition, development, and industrialization in the Malaysian agricultural sector. Scott notes that where some might see his study of peasant farm life as commonplace or banal, others taking a deeper look at his work would see:

*the justification for such an enterprise must like precisely in its banality-in the fact that these circumstances are the normal context in which class conflict has historically occurred. By examining these circumstances closely, it may be possible to say something meaningful about normal class consciousness* (Scott, 1985 p27).

We do not mean to suggest that the scope of this study is equivalent to Scotts' exhaustive work in Malaysia, or that this study about class conflict. However, we do see similarities in how this study explores the normality of the daily experiences of small family farmers in Chatham County. Additionally, we acknowledge the value of this study in documenting the everyday observations and understanding of the farmers as they continue adapting to a changing climate in order to maintain their preferred livelihood and make important contributions to society.

## **WATER RESOURCE MANAGEMENT IN RURAL SOUTH AFRICA: ASSESSING PUBLIC PARTICIPATION THROUGH TRINITY OF VOICE**

Access to a clean and reliable supply of water remains beyond the reach of many South Africans and beyond the capacity of governmental institutions to deliver (UNICEF 2012; World Health Organization 2012; Githeko, Lindsay, Confalonieri, & Patz 2000). Climate change is projected to significantly alter temperature and precipitation patterns, stream flow and other important aspects of the hydrological cycle as well as harvest patterns in South Africa that could adversely affect rural farming communities (IPCC 2014; World Bank 2014; Nare, Odiyo, Fancis, & Ptegieter 2011; Gbetibouo, Ringler, & Hassan 2010; Lumsden, Schulze, & Hewitson 2009; Leichenko & O'Brien 2002).

Challenges to the water delivery system span the local, regional, national, and global levels. Local challenges include bureaucratic impediments, lack of necessary infrastructure or funds to cover development and maintenance costs, leadership or technical expertise, or unauthorized water connections (Nare et al. 2011). Regionally, there is competition among water user groups; nationally, pressure from development and industry tends to exacerbate existing demand (Malzbender et al. 2005). Globally, climate change could adversely impact rainfall patterns leading to either drought or flooding depending on the timing and intensity of the precipitation (IPCC 2014, World Bank 2014).

Researchers contend that climate change will exert differential pressure across various areas of South Africa (Gbetibouo et al. 2010; Lumsden et al. 2009; Leichenko & O'Brien 2002). Many rural areas are ill-equipped to manage the

increasing pressure from climate change stressors including the availability and quality of water, water runoff, soil conditions, health concerns and potential vector-borne diseases, temperature fluctuations, increasing or decreasing demands for energy, potential damages to infrastructure including dams, road, telecommunication networks, or governmental or health facilities (Gbetibouo, et al. 2010).

Much of northeastern South Africa, including the Limpopo area, is considered too dry to sustain most agricultural activities due to limited water resources, therefore cattle or other stock farming dominate land use (DWAF 2004). Droughts are a common occurrence across Limpopo province (Shackleton 2000). Mean Annual Precipitation (MAP) within the water management area containing Limpopo Province varies considerably from 200mm per year in the north to more than 1,200mm per year in the south (DWAF 2004). Climate projections for South Africa for the years 2030 to 2039 indicate that groundwater, precipitation, mean annual precipitation, and the Climate Moisture Index are all projected to decline, while the average change of mean temperature is projected to rise, as is the water available at the basin level (World Bank 2014). Meanwhile, projections from 2050 to 2059 show similar trends except that by that time water storage at the basin level is projected to be trending downward while mean temperature would be trending even higher (World Bank 2014).

This additional climate-related stress adds a layer of complexity to natural resource management making decision making more difficult; therefore, understanding public participation processes regarding water resource management is an important consideration. By conducting a rapid assessment, we were able to

gather an initial understanding of participatory process in Limpopo Province, South Africa regarding water management.

## **Water Resource Management in South Africa**

There are three main levels of federally sanctioned bodies authorized to manage water resources in South Africa. In 1998, South Africa passed the National Water Act (NWA), which made water a public good. Private water rights were terminated and the principles of sustainability, equity, and efficiency were introduced. Since the formation of the NWA, federal officials have attempted to devolve water resource management decision making responsibilities to local authorities (Malzbender et al. 2005). However, the effectiveness of this regime in delivering a safe and reliable source of drinking water to rural South Africans remains uncertain (Nare, Odiyo, Francis, & Potgieter 2011; Malzbender et al. 2005).

On paper, and in government policies, water resource management in South Africa should follow a prescribed pattern of decentralized authority and responsibilities filtering down through multiple provincial and district institutions and settling at the village level (Figure 4.1).

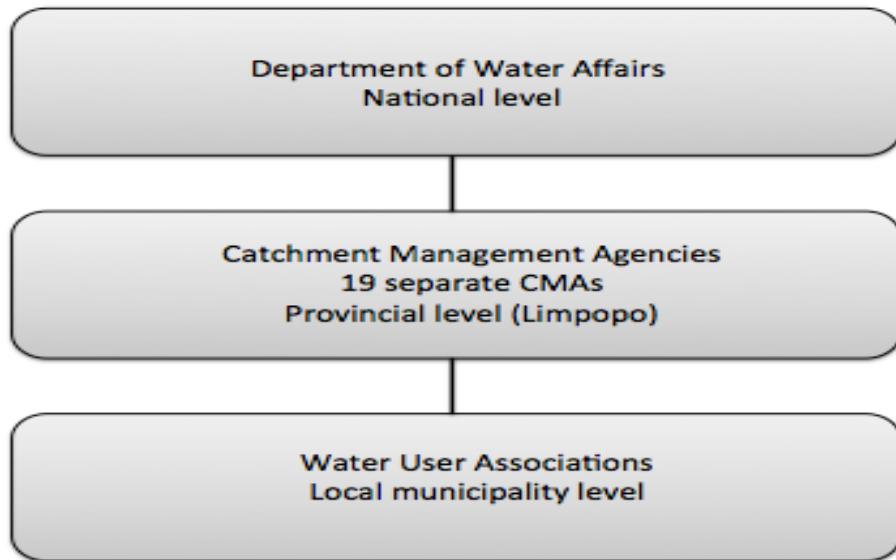


Figure 4.1 Water governance structure in South Africa

At the top of this institutional pyramid is the Minister of Water Affairs and the Department of Water Affairs (DWA), formerly the Department of Water Affairs and Forestry (DWAF). Under the second layer of these newly created federal institutions, water is centrally managed at the catchment level through catchment management agencies (CMAs), thereby representing the second level of water resource management. There are nineteen different CMAs spread across South Africa and each is responsible for a catchment management strategy (CMS) covering its management area. Since water is managed at the catchment level instead of according to political boundaries, the jurisdiction of water management authorities (WMAs) often crosses traditional political boundaries separating municipalities, districts, and provinces. Finally, the third level of water resource management consists of Water User Associations (WUA), which represents a further devolution of authority to local citizens, organizations, and businesses. et al. 2005).

In practice, water resource management decisions in rural South Africa are fragmented between a legislated ideal (the National Water Act); traditional authority at the village level as executed through tribal chiefs, headmen, and water committees; and the informal everyday rule making and water use of local villagers (Kapfudzaruwa & Sowman 2009). Additionally, Kapfudzaruwa and Sowman (2009) note how the 2003 Traditional Leadership and Governance Framework Act suggests that local municipalities and traditional leaders seek out opportunities for partnerships based on respect for their traditional authority, but this Act makes no statutory requirement that the municipalities must include the traditional leaders in decisions about water resource management. This diffusion of authority makes sense in theory, yet in practice, researchers are finding deficiencies in delivery of water and in participatory processes (Nare, Odiyo, Francis, & Potgieter 2011; Maldzbender et al. 2005).

At present, millions of South Africans are still governed through the traditional leadership and authority of chiefs (*hosi*) and headmen (*induna*) at the village level (Giannechini, Twine, & Vogel 2007). These traditional leaders provide authoritative guidance in day to day decision making at the local village level, which includes input about water resource management. Furthermore, and perhaps more importantly these traditional leaders represent an important social and cultural connection to a way of life that transcend the discriminatory practices of apartheid and began long before the establishment of democratic elections in South Africa in 1994 (Giannechini et al. 2007).

Therefore, in many rural parts of South Africa there is at best a dual system of decision making in operation with unclear lines of authority, and at worst, a tension between traditional, village-led leadership and the statutory law as spelled out in Chapter 12, Section 211 of the South African Constitution. Maldzbender et al. (2005: 8) note the existing latent tension that while “recognizing the institution of traditional leadership and the plurality of legal systems, this principle effectively establishes the superiority of statutory law over customary law. In other words, customary law is tolerated only when it does not contradict statutory law.” Similarly, Nare, Odiyo, Francis, and Potgieter (2011) found that this dual system lacked any clearly established processes that would facilitate community participation in water management decision making at the village level.

Detailing the explicit rights and responsibilities of officials to ensure public participation is not a strong suit in either the Constitution or the NWA. Section 80 (e) of the NWA comes the closest when mentioning the function of Catchment Management Agencies is “to promote community participation in the projection, use, development, conservation management and control of the water resources in its water management area” (NWA, 1998 p89). Significantly though, neither the NWA nor any of the other federal institutions regarding water management make explicit provisions for how customary or traditional authority in tribal or village areas is to be incorporated into the decision making process (Nare et al. 2011; Kapfudzaruwa & Sowman 2009; Maldzbender 2005). Understanding how well public participation, the prescribed mandate and the institutions are functioning at the local level, is worth examining, especially given pressures that climate is forecast to bring to the country (IPCC 2014). Thus, the research question for this study asks:

How do water committee members in Hamakuya, South Africa evaluate participatory processes at the village level regarding water resource management?

## **Review of Participatory Literature**

A central tenet in the public participation literature, whether related to water management in South Africa or another country, is that stakeholder involvement in environmental decision making creates opportunities that facilitate a more genuine participatory experience (Klassen & Feldpausch-Parker 2011; Booysen 2009; Norton 2007; Seneca 2004; Arnstein 1969). There are many frameworks and metrics for public participation but most all move along a continuum that cycles from minimal participation or non-involvement to limited information sharing and consultation, to more participation through partnership development and delegation of authority to maximum participation through citizen control and empowerment (Turnhout, Van Bommel, & Aarts 2010; Bishop & Davis 2002; Arnstein 1969). The concerned citizens of South Africa, the DWA and other official water management authorities should fairly assess the participatory processes currently in place, and then jointly determine whether changes are needed.

### ***Participatory practices in South Africa***

Participatory practices in South Africa have a checkered history and tended to favor water development interests above broadening participation. The Frankdale Environmental Health Project was one of the few exceptions and early success stories. Kahn (1998) detailed how the municipal government and community stakeholders in the settlement of Frankdale just north of Cape Town, created

opportunities for many poverty stricken citizens to participate in the decision making process, thereby addressing some of the underlying drivers of poverty in afflicted neighborhoods. All municipalities across South Africa are required by legislative mandate to create five year planning and budgeting documents called Integrated Development Plans (IDPs). Everatt, Marais, and Dube's (2010) study of participatory practices regarding the IDP processes in Gauteng Province, South Africa concluded that although the right to participate was being devolved, and citizens now have the right to participate, "the power to genuinely shape the content of those processes, and to contest and oversee their outcomes, is held elsewhere" (245), meaning not with the general public. The findings of Everatt et al. (2010) align with those of McEwan (2003) who noted that not only did the IDP process fail to deliver on gender equality and participatory promises to women in Cape Town, but instead the government led IDP efforts were coopted by public-private partnerships who were seeking development opportunities. Dressler and Buscher (2008) noted similar participatory failures in government efforts to facilitate livelihood strategies and sustainable natural resource management practices in the Great Limpopo Transfer Park near the Mozambiquan border. Lewis and Naidoo (2004) also documented how development trends were adversely affecting participatory processes designed to improve education policy in Gauteng and KwaZulu Natal.

The track record of government sponsored participatory practices is lamentable and results have not sat well with many South Africans. Perhaps most comprehensively, Booysen (2009) outlines the participatory history of South Africa from 1994 through 2008. Booysen (2009) echoed the participatory ineffectiveness of the top-down IDPs, and noted a surge in public protests, which coincided with the

growing ineffectiveness of government institutions and missed participatory opportunities. Additionally, Smith (2011) concluded that despite the efforts of the South African government to decentralize and devolve authority to local government in hopes of improving service delivery in rural areas and enhancing participatory practices, the results are largely lacking and participation is mostly tokenistic.

Different models, degrees, and dimensions of public participation are important to consider and evaluate. One of many values in encouraging public participation in the management of common pool resources, is that common property design principles suggest that resulting management regimes are usually more sustainable when the user group assists in shaping the rules and management of the resource (Dolsak & Ostrom 2003; McPherson & McGarry 1987).

The literature illustrates how South Africa struggled to establish robust participatory processes in the years following its first democratically held elections in 1994. Although participation was frequently mentioned in IDP documents, and public-private development regimes emerged to address pressing needs, often those regimes and their results left citizens unsatisfied with the participatory processes involved. Even though there is rhetoric in South African laws and institutions about water rights and equity, there are few resources and limited capacity to make that vision a reality in remote villages (Nare et al. 2011; Smith 2011; Malzebender, et al. 2005); therefore it is important to understand participatory processes at the village level. Researchers and practitioners who are interested in governance issues still know little about the nature of participation practices in rural South Africa regarding water resource management decision making. Water committees are part of the

participatory process in rural South Africa, and the theoretical framing of Trinity of Voice provides a framework to begin such an evaluation.

### ***Trinity of Voice as a framework for evaluating participation***

One model for evaluating public participation is Senecah's (2004) Trinity of Voice (ToV). The ToV model seeks to evaluate environmental decision making as a practical exercise whereby participants are afforded meaningful opportunities to contribute to and potentially affect the decision-making process of democratic governance, typically in the context of the United States. ToV consists of three inter-related concepts: access, standing, and influence that form the nucleus of an inclusive participatory process (Senecah 2004). Senecah imagined ToV as a practical model enabling researchers and practitioners to measure the inclusiveness of participatory processes, though the model has not been used extensively.

Even though ToV is specifically designed to examine participatory process, and a few studies showcase the strength of the model to address a variety of issues including those involving natural resource management, it appears that researchers seldom use ToV to evaluate public participation. Using ToV to expressly examine public participation in South Africa holds theoretical significance by stretching the cultural and geographic context for its applicability given that ToV originated in the United States. Additionally, there is applied significance in this study by examining the functioning of a participatory process from the point of view of the participants who live under two forms of governance—traditional rule and Constitutional rule. The lack of studies in the developing world employing ToV represents a deficiency in the literature as well as an opportunity for studies like this

one to fill a gap through a practical examination of public participation that bridges theory and application. A further outline of each part of ToV follows before turning to the results of this study.

### **Access**

The first leg of the ToV model is access. In the most general terms, access speaks to participants having “sufficient and appropriate opportunities to express” their choices and opinions (Senecah 2004: 23). However, this element of participation entails much more than providing stakeholders with just space and time to share viewpoints. Access is characterized as an actively engaged process with decision makers that fosters information sharing with stakeholders in a variety of arrangements and forums that necessarily enable the stakeholders to ask questions for them to understand relevant information (Senecah 2004).

Merritt (2009) used elements of access and standing in a study of local stakeholder perceptions of a negotiated rule making process related to piping plovers in North Carolina and found ToV a constructive model for understanding how the various stakeholders created participatory space and opportunities for the various and sometimes conflicting perspectives. To operationalize access, Merritt (2009) asked participants a number of questions including whether the meetings organized by the National Park Service (NPS) were held at convenient times and in convenient places or not, and whether or not the participants felt that all of the stakeholders affected by the Negotiated Rulemaking process were represented at the meetings. Because Merritt (2009) asked stakeholders about the openness and availability of opportunities to express their sometimes dissenting opinions, the stakeholders felt

they were part of the decision making process and that their opinions were welcomed by the authoritative officials.

ToV allowed Klassen and Feldpausch-Parker (2011) to articulate the ineffective expressions of voice and frustration of local officials who thought citizens did not understand the bigger picture, and citizens who thought that officials were dismissive of their concerns. Klassen & Feldpausch-Parker (2011) used ToV to compare the participatory process of organizations in two communities (one in Rosemount, Minnesota and the other stretching across towns along the New Mexico and Colorado border) working to balance the need for additional energy exploration and development with concerns over potential damage to the environment. Their research demonstrated how access and information sharing opportunities were leveraged in communities across New Mexico and Colorado to empower the residents as participants in the decision making process through community coordination, outreach, and multiple meetings with various stakeholders.

Walker, Seneca, and Daniels (2006) organized feedback from citizens to understand how public participation efforts might be improved in terms of natural resource management in the Allegheny National Forest in Pennsylvania and the Columbia River in the Pacific Northwest. The access component of ToV allowed Walker et al. (2006) to demonstrate that stakeholders were most concerned with having multiple meetings at different times of day and on different days, getting more people involved in the process, and in making information more readily accessible. Furthermore, ToV was useful in understanding how citizens thought that there were community partners and additional stakeholders who should be involved in the decision making process but who were not originally included in discussions.

By understanding the importance of participation and access, citizens and officials could collaboratively improve forest management and sediment management plans.

Access is probably the easiest identifiable element of ToV including time, information, assistance, competence, and opportunity to participate and provides the foundation for the ToV evaluative process (Senecah 2004). What we know about access is that convenient days and times to participate, intelligible information, assistance with technical details, and welcoming opportunities to participate are necessary initial steps to create a participatory environment. The examples above demonstrate how access can lead to a more inclusive and participatory process, and foster support for decisions.

### *Standing*

The second leg of the ToV model is standing. According to Senecah (2004: 24), standing addresses “the civic legitimacy, the respect, the esteem, and the consideration that all stakeholders’ perspectives should be given”. This conceptualization of standing is different from the meaning of standing in a legal sense. Senecah (2004) envisioned standing as a mutual expression of regard for all participants that is evident through the way people comport themselves during the decision making process, their conversational style with one another, nonverbal behavior, clearly explaining procedural steps and roles of authority, as well as eliminating subtle proxemics or staging apparatus that indicate authority and convey intimidation.

Walker et al. (2006) utilized standing to demonstrate the importance of using impartial facilitators, a need for open and multiple communication and information

outlets, addressing the behavior and non-verbal communication of government officials, and openly reconciling issues about decision space when it comes to input from citizens. Similarly, Singh, Koku, and Balfors (2007) used standing and ToV to document the nature of disputes between mining companies interested in expanding their operations and local stakeholders concerned about water quality in Ghana. Singh et al. (2007) noted differences and communication gaps, a lack of transparency, and distrust between officials with mining companies and host communities, and how those differences led to water-related conflicts. More specifically, Singh et al. (2007) described how mining authorities in Ghana failed to acknowledge the standing of the local community and subsequently failed to hear or even consider the concerns of the citizens, and put forth little effort to include them in any of the decision making deliberations. The disregard shown for the concerns and opinions of the local communities further eroded what little trust there was between the Ghanaian mining officials and local citizens.

Klassen and Feldpausch-Parker's (2011) study demonstrated how a lack of coordination and standing in Rosemount, Minnesota limited the participatory effectiveness of those citizens concerned about new energy exploration projects. The standing component of ToV provided Klassen and Feldpausch-Parker (2011) the analytical lever to show how Koch Industries legally limited the participation of citizens who were organizing through their local Community Advisory Council (CAC), thereby disrupting the efforts of the citizens to participate in and influence the decision making process. Meanwhile, Merritt (2009) probed the standing element of ToV by asking stakeholders if they felt that members of the NPS and rulemaking committee in the piping plover case were listening to the concerns of the

stakeholders and each other. Merritt also asked if there were opportunities for questions, discussion, and deliberation between the NPS and the rulemaking committee or not.

The literature on ToV and standing demonstrates that the dynamics of how citizens participate and how their participation is allowed to affect the decision making process are both important considerations. As researchers continue to ask questions about standing, we discover more about the nature of public participation, the quality of those processes, and how participatory dynamics can foster or hinder participation.

### *Influence*

The third leg of the ToV model is influence, and stems from but is not guaranteed by having achieved access and standing. For this element of the model, Senecah (2004) does not necessarily mean that a participant was successful in securing their preferred outcome, but rather that their ideas were afforded respectful consideration and that they were active participants in determining the decision criteria and alternatives under consideration.

Klassen and Feldpausch-Parker (2011) show how inter-connected the three elements of ToV are and how fragile public participation can be even if two communities are dealing with a similar issue. Because citizens of one community, Rosemount, Minnesota, lacked standing with Koch Industries those concerned citizens were unsuccessful in participating in the decision making process. Conversely, citizens in the San Juan Basin in New Mexico and Colorado were able to broadly establish both access and standing with the oil and gas industry, government

representatives, and a diverse segment of the area and were able to actively participate in the decision making process—thereby achieving influence (Klassen and Feldpausch-Parker 2011). Because the citizens in New Mexico and Colorado achieved access, standing, and influence their efforts resulted in legislation protecting their rights.

What we know about influence can be summed up through the work of Smith (2011) who drew on elements of ToV to evaluate public accountability and participation in terms of water services in Cape Town and Durban, South Africa. Smith (2011) documented the challenges that citizens of Cape Town and Durban experienced while trying to establish and participate in an officially sanctioned and decentralized services board. Smith discovered a lack of institutional support and political fragmentation among officials that diminished ability of the citizens to participate in the effective oversight of municipal services. Smith's (2011) study documents how even though the citizens had access, they experienced limited standing with municipal officials and exercised little influence over a municipal-sponsored program designed to incorporate their participation.

The literature demonstrates that ToV is a flexible, resilient model suitable for a variety of analytical investigations. By exploring access, standing, and influence, researchers dig deeper into the functioning processes and procedural limitations of participatory practices. Senecah (2004) introduced access, standing, and influence not as standalone parts of a process but as serviceable grammars of a functioning participatory process. Because access, standing, and influence are concepts of participation that are pragmatic and sensible to researchers, practitioners, and citizen-stakeholders alike ToV is a practical rubric to evaluate public participation.

From the ToV literature and the participatory practices of South Africa we consider ToV an appropriate model for exploring water governance in rural South Africa. To begin exploring water governance and public participation in rural South Africa, we needed to select a methodology for the study. With an understanding of our resources, time constraints, and established contacts in Limpopo Province, we determined that a rapid assessment would be the best approach. A review of rapid assessments as a way to begin exploring issues of natural resource management is detailed below and provides justification for our approach.

## Study Context

Fieldwork was conducted in the Hamakuya region, a group of local communities in the northeastern section of South Africa. Hamakuya is in the Vhembe District of Limpopo Province located near the Mutale River. Limpopo shares a border with Zimbabwe to the north, Mozambique to the east, Botswana to the west, and is situated just west northwest of Kruger National Park (Figure 4.2).



Figure 4.2 Location of Hamakuya and the Provinces of South Africa  
Adapted from Sartorius & Sartorius (2013)

The northeastern part of South Africa is considered bushveld, or savannah, consisting mostly of trees and mixed vegetation. During the dry season, which occurs during the winter months, May to September, the region gets very little precipitation creating water stress for humans and animals alike (Statistics South Africa, 2012). The wet season occurs during the summer months, which run from October to April when the region routinely receives over 50mm of rainfall per month. On average, the Limpopo Province receives roughly 475mm of rain per year (World Bank, 2014). A more immediate concern for agricultural producers, large and small across South Africa are potential changes in patterns related to the intensity and frequency of precipitation rather than the amount of rain received in a particular area (Gbetibouo et al. 2010; Lumsden et al. 2009).

Census data for the years 2001 and 2011 in the Hamakuya region are shown in Table 4.1. Nearly 97% of the locals live in traditional or tribal housing, while the remaining 3% are in urban areas. Subsistence farming plays a central role for most households in the region. Agricultural production is split along these activity lines: 26.5% livestock, 24.1% poultry, 21.2% vegetable, 24% other agricultural crops, and the remaining 4.3% other (Statistics South Africa, 2012).

Table 4.1 Comparative census data from 2001 and 2011 for the Hamakuya region

<b>Attribute</b>	<b>2001 Percent</b>	<b>2011 Percent</b>
Unemployment rate	56.8%	48.8%
Female headed households	55.6%	54.8%
Electricity for lighting	39.0%	83.3%
Piped water inside house	3.4%	5.8%

Source: Statistics South Africa (2012)

Because many citizens in Hamkuya remain unemployed and lack piped water inside their home (Table 4.1) they have fewer resources thereby limiting their ability to adapt during times of drought or excessive precipitation that are likely to occur and be exacerbated with climate change (Gbetibouo et al. 2010). Even though the unemployment rate decreased by 8%, the rate is exceptionally high. Furthermore, less than 6% of villagers living in Hamakuya have water piped directly into their home.

This study grew out of a research program initiated in 2011 focused on providing graduate students with training and experience conducting interdisciplinary research. In 2011 The IMAGINE (International Mentoring of Advanced Graduates for INterdisciplinary Excellence) brought together graduate students and faculty from numerous disciplines including conservation and ecology, educational psychology, environmental technology and policy, and cultural anthropology to name few from universities across South Africa, the United States, and Canada. The IMAGINE program continues to explore a variety of social, biophysical, political and cultural issues related to water quality and availability, rural livelihood strategies, as well as coping mechanisms. Field work from 2011 in Hamakuya showed that villagers reported water as their key asset in the community, though many expressed concern about water availability (Steelman et al. under review). Additionally, researchers in 2011 heard local villagers mention water committees play a role in making decisions about how to use water (Steelman et al. under review). The water committees and the villagers concern about water availability provided the basis for the 2012 field work reported in this study.

Imagine has been operating continuously since 2011 in South Africa. During this timeframe, Dr. Melissa McHale, the Principal Investigator on the project, has provided theoretical, methodological and practical continuity to the multiple data collection efforts that have taken place over the years. The research from my time in Hamakuya in 2012 has been supplemented by other studies over time. This study was designed and should be read as an exploratory study fitting into the broader, more comprehensive, and ongoing research effort being conducted through the IMAGINE program. Additional limitations of this study are discussed in the subsequent sections.

## **Methods**

Given some of the constraints going into this study, we determined that a rapid assessment was our best option (Beebe 1995). By working through the elements of a rapid assessment, it was possible to gather enough contextualized data to begin making field-based observations about public participation in water resource management decision making in Hamakuya, South Africa. A more detailed explanation of rapid assessments follows the section on data collection.

### ***Data collection***

A water governance team was assembled in January of 2012 to begin constructing and refining the data collection processes and procedures that would be undertaken while in the field in South Africa in May 2012. Drafts of focus group questions and a protocol were created based on the literature and revised several times during March and April 2012 prior to the team leaving for South Africa.

Revisions were based on feedback from faculty who had worked in Hamakuya previously. Once the water governance team arrived in country in May of 2012, the questions and protocol were revised again based on additional feedback from a renowned South African scholar who was also participating in the program. The final version of the focus group protocol contained 27 questions.

Through the IMAGINE program, an interdisciplinary team of graduate students and faculty researchers from four universities from three countries was assembled for the fieldwork in May 2012. Gaining exposure to the local culture was an important part of the data collection process, so students were divided into research teams and stationed in each of the three villages for home stays. The home stays were an important component because they allowed for a deeper understanding of local context including informal conversations to develop between villagers and students as well as providing students with opportunities to assist the host families with some of their daily chores including collecting and transporting water. Home stays took place on June 1-3, 2012.

Graduate students and faculty members conducted three focus groups in May 2012 that were held simultaneously with the assistance of Tshulu Trust, a local non-profit located in Guyuni Village, Hamakuya that also serves as a research station for local and visitors scholars. Data were collected from residents of the villages of Maludzawela, Musunda and Mbuyuni, and Sanari. Participants were selected based on their involvement in water committee work and knowledge about water committees. Two male villagers from Maludzawela participated in one focus group (n=2), two male and three female villagers from Sanari attended another (n=5), while three female villagers from Musunda and Mbuyuni participated in the third

focus group (n=3). The focus groups were smaller than originally intended but illustrate one of the challenges of conducting qualitative field research in complex settings (van Kerkoff 2014). Tshulu Trust had been instrumental in securing commitments from additional villagers to attend the focus groups, but when the time came to conduct the meetings fewer villagers showed up because government child support payments were being distributed that day. Participants did not want to run the risk of missing their payments and elected to stay home.

A cadre of local interpreters was employed during the data collection procedures. Interpreters also played an instrumental role in assisting the research team by providing valuable feedback on the focus group questions, gathering informed consent from the village participants, and making certain that the project descriptions would be intelligible to the villagers. All focus group questions were administered orally, originally asked in English to an interpreter who then communicated the questions into Tshivenda, the local language, for the participants to answer. Answers were then reverse interpreted back into English by the interpreters.

Water committee members were asked a series of semi-structured questions, listed in Table 4.2 regarding decision making about water resources. Key questions used by the water governance team during the three focus groups were derived from the ToV literature and centered around access, standing, and influence. The water governance team was also interested in hearing what the water committee members understood the role and responsibility of water committees to be.

Table 4.2 Sample of questions asked during focus groups

<b>Trinity of Voice</b>	<b>Question</b>
Access	How do villagers become members of the water committee?
	How are meetings announced?
	How frequently and where are meetings held?
	Can anyone raise an issue at a meeting?
	Have committee members heard of the NWA?
Standing	Does the water committee hold different types of meetings?
	Are meetings open to all villagers?
	How/who developed the local rules about water usage?
	Are water committee and villagers listening to each other?
Influence	Do water committee members understand technical issues about water delivery?
	Is the water committee obligated to include input from villagers?
Function of water committee	What can villagers do if they do not agree with a decision?
	What is the role and responsibility of the water committee?

Asset mapping exercises which encourage participants to illustrate and discuss the natural, physical, social, and cultural resources within their community (Campo & Wali, 2007), were conducted at the beginning of the focus groups. These exercises allowed time for the villagers and the researchers to interact a bit more informally and build on rapport that might have been established during the home stays. Research teams used 1) a local interpreter, 2) a lead interviewer, 3) a lead note taker, and 4) a backup note taker for each of the three focus groups to facilitate accurate data collection. Detailed notes were taken for both the asset mapping and

the focus groups. The meetings were recorded and the audiotapes of those discussions were transcribed verbatim. Topical codes were developed before data collection and mirror the key questions from Table 4.2 which were covered in the focus groups and represent a deductive approach based on the ToV literature. Topical codings of the focus group transcripts were tested for consistency and reliability using two external coders.

### ***Rapid assessment***

Rapid assessments are commonly used by non-governmental organizations (NGOs), government agencies, and researchers (Adler 2013; The World Bank 2010; Mickkelsen 2005). Rapid assessments, or rapid appraisal as they are sometime called, emerged as an effective and worthwhile approach for conducting research in developing countries the 1970's (Beebe, 1995). Since that time rapid assessments have been used in a variety of locations and for a range of applications including tourism, natural resource management, and water-related research projects.

For example, de los Reyes (1984) used rapid rural appraisal with farmers in the Philippines to examine and untangle issues involving community irrigation systems, while Chambers (1987) found rapid rural appraisals similarly successful in aiding practitioners with a cost-effective tool capable of addressing poorly performing irrigation systems. Conway (1985) presented rapid appraisals as an important additional approach for researchers to consider using to augment more traditional integrated rural development (IRD) strategies since rapid appraisals are flexible and foster participation among and between researchers and participants. Conservation International (1991) saw the value that Conway (1985) mentioned and

used a rapid assessment in Bolivia to document not only the health and biodiversity of the Alto Madidi region but also the vulnerability of the species and area if conservation efforts failed to protect the natural heterogeneity of the Andean forests.

Cifuentes, Alamo, Kendall, Brunkard, & Scrimsha (2006) used rapid rural assessment to explore the efficacy of public and environmental health programs designed to address issues caused by poor sanitary infrastructure and limited water resources in communities near the Mexico-US border. Rapid assessments have also proven to be an effective method of addressing public health issues stemming from drug use especially with researchers in Sub-Saharan Africa (Adelekan 2000).

A strength and weakness of rapid assessments is its flexibility, but when conducted with diligence and care, rapid assessments are an important “tool for starting the learning process” (Beebe, 1995 p48). Central tenets of rapid assessments vary from researcher to researcher, but there are a number common concepts that are present and recognizable in various combinations across rapid assessments. Seven of those common elements are: (1) rapid and progressive learning, (2) learning directly with and from rural communities, (3) triangulation, (4) limiting established biases, (5) leveraging trade-offs, (6) iterative analysis and data collection, (7) taking a system perspective (Beebe, 1995). Table 4.3 presents these elements, briefly explains them and how they were operationalized in this study.

Rapid assessments, like other methods, have limitations. A key strength and criticism of rapid assessments is its flexibility (Beebe, 1995). Inexperience with qualitative research methods, a failure to include a checklist, and working independently can significantly reduce the rigor of a rapid assessment, but by

working in a team environment and with experienced qualitative scholars can improve the confidence in the results (Beebe, 1995).

Table 4.3 Elements of a rapid assessment and its operationalization in this study

<b>Common Concepts</b>	<b>Operationalized in Hamakuya</b>
Rapid – Progressive Learning <ul style="list-style-type: none"> <li>• Through semi-structured interviews, short guidelines and team preparation</li> </ul>	<ul style="list-style-type: none"> <li>• Advance and continuous meetings with the Governance Team members December 2011 - May 2012</li> </ul>
Iterative analysis and data collection <ul style="list-style-type: none"> <li>• Flexibility to adjust preliminary hypothesis during data collection</li> <li>• Flexibility to adjust the data collection process based on gathered information</li> </ul>	<ul style="list-style-type: none"> <li>• Pre and post-focus group debrief meetings</li> <li>• Review and revision of the semi-structured focus group interview guidelines based on evolving understanding of the cultural context</li> </ul>
Learning directly with & from rural community members <ul style="list-style-type: none"> <li>• Identifying key informants</li> <li>• Taping into indigenous knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Homestays in the three villages</li> <li>• Field work and data collection with villagers</li> <li>• Collaboration with Tsulu Trust, a local non-profit to facilitate research</li> </ul>

Table 4.3 Continued

Common Concepts	Operationalized in Hamakuya
<b>Triangulation</b> <ul style="list-style-type: none"> <li>• Multi perceptions and methods from diverse teams</li> <li>• Information gathered in advance</li> <li>• Direct observation</li> </ul>	<ul style="list-style-type: none"> <li>• Iterative discussions with team members to understand and engage in sense making</li> <li>• Field observation, data collection, and daily task participation</li> <li>• Local participation</li> </ul>
Limiting established biases <ul style="list-style-type: none"> <li>• Use of multidisciplinary teams, prior knowledge, and feedback sessions</li> </ul>	<ul style="list-style-type: none"> <li>• Graduate students and faculty from multiple universities used during field work, data collection, and focus groups</li> </ul>
Leveraging trade-offs <ul style="list-style-type: none"> <li>• Working with key partners and team member assets</li> </ul>	<ul style="list-style-type: none"> <li>• Several project team members worked in Hamakuya previously</li> <li>• New team members brought fresh disciplinary perspectives</li> <li>• Locally based collaborator, Tsulu Trust, facilitated research and capitalizing on needs for the community</li> </ul>

Table 4.3 Continued

<b>Common Concepts</b>	<b>Operationalized in Hamakuya</b>
<p><b>System Perspective</b></p> <ul style="list-style-type: none"> <li>• Assumption that key elements of the system and their importance cannot be fully understood ahead of time</li> <li>• Use of indigenous knowledge</li> <li>• Use of local definitions</li> </ul>	<ul style="list-style-type: none"> <li>• Field training in Social-Ecological Systems (SES)</li> <li>• Team members included native South African scholars as well as scholars from neighboring countries</li> <li>• Used local interpreters to translate questions into local language</li> </ul>

Adapted from Beebe (1995)

## **Findings**

Responses from the participants of the three focus groups illustrate both the similarity and differences of understanding about the water committees, local decision making processes, rules, and public participation in those processes. In accordance with Institutional Review Board policies, personal identifiers associated with participant responses were not used freeing focus groups leaders to concentrate more fully on the conversation. Responses by committee members from Maludzawela are identified as Village 1; responses by committee members from Musunda and Mbuyuni are identified as Village 2; while responses by committee members from Sanari are identified as Village 3. Quotes and comments by the committee members have been grouped into themes and reported below according to their relation to access, standing, and influence.

The first section below covers discussion related to access. Questions explored how villagers became a member of the local water committee, whether the villagers have heard of the National Water Act or not, the types of meetings that are held related to water, getting an issue on the agenda for a water committee meeting, as well as how meetings are announced, their frequency, and location.

### ***Elements and responses related to access***

- How villagers become members of the water committee? There were differences of opinion and experience about how villagers become members of a water committee. There was more agreement among focus group members that the headman and chief play a role in the selection process than do the villagers themselves. Participants from Village 2 agreed that villagers were elected from

the community to be on the water committee while one participant from Village 1 said that water committee members were appointed by the headman along with previous members of the water committee. Another water committee member from Village 1 commented, “*they have a meeting with the headman, then they select which one will be on the committee. Then the community votes for their name if they would like them on the committee. It is all done at the headman’s house and the headman meets with the old water committee.*” Participants from Village 3 reported that committee members are “*chosen from the village*”, though they could not explain how exactly.

- How are meetings announced? From the focus groups we learned that the villages hold at least two types of meetings, one that is open for all villagers to attend but may not be limited to water issues, and another just for the water committee members and whomever else they meet with to discuss water related issues. Additionally, after asking how frequently and where are meetings held, we discovered that the frequency, timing, and announcement of water committee meetings tended to vary according to the preferences of the village or those setting the schedule. There were private meetings that only the water committee members attended and also a general or public meeting that was open to the public. A Village 1 participant stated, “*they can have private meetings only for the water committee, and then tell everyone what they’ve been talking about.*” While a Village 2 participant claimed, “*they have the committee meeting and then after the committee meeting they will call the general meeting which is*

*attended by all of the community.”* The location of water committee meetings varied. According to committee members from Village 3, some of the time the meetings are held at the headman’s house while at other times the meetings are held in various locations around the villages. In Village 1, water committee meetings are held every two months, while in Village 2 meetings are only held when there is an issue to be discussed. In terms of receiving advance notice of the meetings, villagers in Village 1 ring a bell to announce a water committee meeting. Members from Village 2 reported that a seven-day advance notice is given to prior to holding a meeting, and committee members from Village 3 said that they distribute a notice that is passed around villagers calling it “*a timetable with the meeting day and time*” that each person receives saying, “*this is enough time for us.*” Across the three villages, water committee members reported that neighbors take it upon themselves to inform others living nearby about an announced meeting.

- Can anyone raise an issue at a meeting? Water committee members provided mixed input on this issue with some saying that anyone can raise a question or concern at a water committee meeting. A participant from Village 2 noted, “*at the water committee meeting, the community is not allowed to bring in input, but they have to bring in their input while attending the general meeting*”, while a water committee member from Village 1 said, “*yes, anyone can put an issue on the agenda.*” Committee members from Village 3 said, “*no, the person would just go and tell the headman about the issue.*” There was discrepancy in responses from committees members from Village 3, which was made up entirely of women,

suggesting that women may not be allowed to raise an issue for discussion in these villages. Villages 1 and 2 reportedly allowed women to raise questions at water committee meetings. This mixed message about the ability of villagers to interject during a water committee meeting suggested a lack of clarity regarding the norms of public participation.

- Have committee members heard of the National Water Act (NWA)? None of the water committee members reported familiarity with the NWA. One of the primary conditions of participating in any decision is being informed of and knowing your rights. The NWA is the South African law outlining water as a right for all residents of the country. As no water committee members had heard of or understood their rights as expressed in the NWA, it is not unreasonable to conclude that villagers in Hamakuya lack access in terms of this critically important foundation.
- Residents and water committee members in Hamakuya expressed a variety of experiences related to access as shown in Table 4.4. While some committee members in Hamakuya were said to have been appointed by the headman others were said to have been elected or chosen by the villagers. This either demonstrated autonomy for the villagers or perhaps a breach of rules, but is worth further exploration. While water committee members and villagers reported to have participated in the development of water usage rules, the extent and role of involvement of headman in the process remained unclear. Although

committee members and villagers expressed satisfaction with the timing, location, and agenda setting procedures, a significant deficiency was exposed in terms of how uninformed all the villagers of Hamakuya were about the NWA and their rights regarding water.

Table 4.4 Elements related to access

<b>Village 1 (2 male)</b>	<b>Village 2 (3 female)</b>	<b>Village 3 (2 male, 3 female)</b>
Water committee members were appointed by headman & elected by the community	Water committee members were chosen by the community	Water committee members were elected by the community
Ring bell to announce meeting	Distribute note to announce meeting	7 day advance notice to announce meeting
Villagers inform one another about meeting	Villagers inform one another about meeting	Villagers inform one another about meeting
Anyone can raise an issue at meeting	Disagreement about women being able to raise an issue at meeting	Anyone can raise an issue at meeting
Unaware of National Water Act	Unaware of National Water Act	Unaware of National Water Act

### ***Elements and responses related to standing***

- Are meetings open to all villagers? Across all three villages, the participants reported that all villagers were welcome to attend general meetings. This is a bit inconsistent with findings above where villagers reported that there were meetings which they were prohibited from attending, but does clarify the fact that the villages hold at least two types of meetings that deal with issues related to

water. The exact nature of the open and closed meetings calls into question the standing of villagers to participate in local resource management, and the relationship between community members and the water committees, community members and the headman, as well as the water committee and the headman.

- How/who developed the local rules about water usage? Water committee members across all three groups reported that the headman made rules about how and when to use water, but the committee members did not report that only the headman made the rules. A committee member from Village 3 suggested that it is “*the headman, to prevent people from wasting water*”, a committee member from Village 2 said, “*from the headman, he says that if you have been elected on the water committee, it’s like the chief and headman will organize a workshop for them about how they are going to work.*” Another committee member from Village 2 said, “*I think the community is more involved in the decision making. The community is the one that comes with the consent.*” Committee members from each of the three villages reported uniformly that they have similar rules about water use, a member from Village 1 said rules state: “*no washing or bathing at the taps*”, “*children cannot play at the taps*”, “*no cattle are allowed near the taps*”, and a need to prevent people from other villages from using their taps. A member from Village 1 reported, “*most people are happy with the rules*” while a member from Village 3 stated, “*everyone knows the rules and all follow the rules.*” Furthermore, “*if there are no rules, that means everyone will just do*

*anything he wants to at anytime,”* according to a member from Village 2. A committee member from Village 1 reported that people have been rebuked for breaking rules related to water usage, “*They will just get a fine for your money, 20 rand. The headman takes 20 rand. No one else can fine you.*” Another member from Village 1 stated, “*they (the headman) can rebuke him or have him to pay a fine. Maybe they warn him and if they see that he is going on with the same thing then they take a fine*”, while a member from Village 2 said if people continued to break the rules “*they will just change the rule around to be a 500 rand fine.*”

- Are water committee members and villagers listening to each other? The fact that the water committee members felt that villagers listened to what they had to say, and that villagers trusted them are both good, initial indications of the standing afforded villagers. A committee member from Village 2 said, “*if they are having an issue they come in time for us to respond*” and “*yes, they the water committee takes the consent of the community, then they are able to make a decision.*” A committee member from Village 1 said, “*they do talk to the villagers and respond to them, if there is a meeting, they collaborate.*” The water committee members reported that the villagers listen to what they say about water usage. One committee member from Village 3 stated, “*the villagers do listen to them because when there is no water, they come to the water committee and ask, ‘why are we not having water?’*” and a committee member from Village 1 said that they feel the villagers trust them noting, “*they never have any comment*

*about any water problem.”* The water committee members consistently reported across all three villages that they do listen to the concerns of the villagers and is indicative of their attempt to provide a degree of standing between the villagers and the water committees.

- Do water committee members understand technical issues about water delivery? Being willing to explain important or complicated technical issues demonstrates a commitment to enhancing the standing of a stakeholder. The water committee members from the three villages were split on this question. Committee members from Village 1 said that water committee members and villagers do understand the complicated, scientific or technical issues related to water delivery while members from Village 3 felt that most villagers do not understand the technical or scientific details related to water and water delivery. Given that water committee members were split on this question we should exercise caution that the participants may have reported socially desirable answers about their understanding. This suggests an uneven pattern of understanding and that additional work related to ensuring technical issues are understood could be undertaken to enhance standing.
- Initial findings related to standing of the villagers to the water committee are presented in Table 4.5 and are similar to those regarding access, in that villagers in Hamakuya reported sufficient satisfaction with the rules and water committee members. However, we began to understand that there is an unclear and complex

relationship between the villagers, water committee, headman, and the village chief. Water committee members stated that villagers were listening to them and they were listening to the villagers about this most important community asset (IMAGINE 2011). However, as with access, there appeared to be some confusion about whether villagers were able to attend (water committee) meetings, or whether committee members understood technical issues related to water delivery and quality necessary to make informed decisions or rules. In general, the responses raised questions about the standing of the villagers and the committee, as well as the influence of the headman over the villagers and water committee.

Table 4.5 Elements related to standing

<b>Village 1 (2 male)</b>	<b>Village 2 (3 female)</b>	<b>Village 3 (2 male, 3 female)</b>
Rules were made at private meetings	Headman made the rules with community involvement	Headman made the rules
Similar rules about water use across the 3 villages	Similar rules about water use across the 3 villages	Similar rules about water use across the 3 villages
Headman can levy a fine for violating the rules	Headman can levy a fine for violating the rules	
Water committee and villagers are listening to each other	Water committee and villagers are listening to each other	Water committee and villagers are listening to each other
Water committee understands technical issues about water/delivery		Does not understand technical issues about water/delivery

### ***Elements and responses related to influence***

- Is the water committee obligated to include input from villagers? Incorporating the feedback of stakeholders into the decision making process sends important signals to participants that their concerns and opinions matter, and are taken into consideration (Senecah 2004). It is unclear whether there is an express obligation to include the concerns or viewpoints of the citizens into the decisions of the water committee. One water committee member from Village 1 said, “*there is a social obligation, but not a legal obligation.*” Committee members from Village 2 suggested that the committees are obligated to hear the input of villagers, but it is unclear if and how that input was to be incorporated.
- What can villagers do if they do not agree with a decision? Water committee members were asked what villagers had the right to do if they did not like a decision made by the committee. Having guidelines about how disagreements or conflicts over decisions are to be resolved is an important procedural component of participation that speaks to influence. Participants expressed a range of solutions to addressing disagreements about decisions, and each of them felt their community had a procedure in place to handle such a situation. Some committee members reported that the villagers could raise their concerns at a community meeting, others said that villagers would meet at the chief’s house, while others said that the water committee would not be involved in the process but instead the villagers would go to the headman. One member from Village 2 said, “*they will call the headman and then clarify the challenges which they face*

*with the community*" while a member from Village 3 stated, "*the headman will come with the solution just because everyone respects the headman.*" A committee member from Village 1 said, "*people have the right to say 'I don't consent' - whatever the decision the water committee makes, the community can deny it if they are not agreeing with the committee.*" How disagreements are ultimately resolved in Hamakuya remains uncertain, but villagers were certain that there are unwritten rules about doing so.

- Initial findings regarding influence indicate that there is an informal system of dispute resolution and social obligation to incorporate input from villagers into decisions about water resource management. The informal systems and norms speak to villagers enjoying a dimension of influence from their participation.

A final question addressed the role and responsibility of the water committee. The inquiry was designed to explore how the water committee members understood their job in making collective decisions for the village.

### ***Role and responsibility of the water committee***

- What is the role and responsibility of the water committee? Water committee members were split on this issue. While some respondents suggested that the role of the water committees was to be responsive to the concerns of the villagers, others said that committee members were merely responsible for delivering messages from the village chief and headman to all the villagers. One committee member from Village 2 said, "*the water committee is just a way to inform the*

*villagers of the changes about water, the chief or the headman speaks to the water committee and the water committee explains to the village what they said*" while a member from Village 3 said that the committee is "*always moving around the village and checking the taps to see whether people are getting water or not.*" Committee members from Village 1 said, [we] "*sit down and see how many people agree with a decision, [and] work on majority. If the majority are saying we want this, it is ok, but if the majority is not, then it is not likely.*"

- Our understanding of the role and responsibility of water committees remains unclear. While some understood the committees to be intermediaries between the chief or headman and villagers, others understood the role of committee members to be a kind of roaming village watchman charged with hearing complaints and identifying potential violations of the rules. Table 4.6 presents data from the three villages pertaining to influence and the role of water committees.

Table 4.6 Elements related to influence

Village 1 <b>(2 male)</b>	Village 2 <b>(3 female)</b>	Village 3 <b>(2 male, 3 female)</b>
Water committee has a social obligation to include input from villagers, but no legal obligation		Water committee has an obligation to hear from the villagers, but no obligation to include their input

Table 4.6 Continued

<b>Village 1 (2 male)</b>	<b>Village 2 (3 female)</b>	<b>Village 3 (2 male, 3 female)</b>
Community can reject a decision by the water committee	Community talks to the headman if they dislike a decision by the water committee	Community talks to the headman if they dislike a decision by the water committee
Community bases decisions on the basis of majority	Water committee passes along information from the chief and headman	

Together these data related to access, standing, and influence began a process of exploring how members of water committees understand water governance and decision making process in the Hamakuya region of South Africa. Findings from this study illustrate considerable uncertainty related to access, especially concerning the basic functioning of water committees and water rights as prescribed in the National Water Act. Findings related to standing show villagers on better footing including mutual respect between the villagers and the water committee, the rules governing water use and potential sanctions for misuse, yet there remains room for improvement regarding technical issues about water delivery and the different types of meetings being held in the village. Elements pertaining to influence reflect the informal nature of water resource management decision making in that there is no clear understanding of the obligation of water committees to include villager input into their decisions or not. Again, findings from this study should be interpreted cautiously given the limited scope associated with a rapid assessment.

## **Discussion**

This study was designed to capture the experience of villagers in rural South Africa to better understand public participation regarding water resource management decision-making. This study presented the perceptions of water committee members in Hamakuya regarding their village's level of input in managing water resources and the functioning of water committees.

Because this particular study is part of a larger ongoing research effort conducted through the IMAGINE program, now entering its fifth year, this rapid assessment represents just one small piece of much larger effort and was never intended to function as the definitive word on public participation in rural South Africa. The rapid assessment was meant to serve as a way for the IMAGINE program to strategically scope the feasibility of conducting a more in-depth study of public participation in Hamakuya, and plan appropriately for how to leverage the programs limited resources in future projects.

Three important new findings emerged from this study. First, a significant portion of villagers and water committee members are not aware of the constitutive policy regarding water resource management—the National Water Act of 1998. This finding is significant because it aligns with the findings of Kapfudzaruwa and Sowman (2009) who found a fragmented system of decentralized water resource management from the federal level down through to the local municipalities. Furthermore, the message that citizens have a constitutional right to water as prescribed in the NWA has not reached villagers or water committee members in Hamakuya, and reinforced the findings of (Nare et al. 2011; Maldzbender et al.

2005) who noted deficiencies in the participatory processes and delivery of water in South Africa.

Second, there is a considerable lack of uniformity in understanding the role, responsibility, and authority of local water committees. The limitations noted above ripple through the local committees as each village expressed a slightly different understanding of what the water committees are supposed to do. Maldzbender et al. (2005) noted the uncertainty of authority at the village level, which lies below Water User Associations (WUA) in the decentralized hierarchy of water resource management. Additionally, the lack of clearly defined roles and responsibilities of water committee members echoes the findings of Everett et al. (2010); Booysen (2009); and McEwan (2003) who all documented the participatory weaknesses of the IDP process in South Africa.

Third, we learned that the headman appeared to play a significant role in water resource management in the villages, which called into question if and how headman and water committees share decision making authority. This finding begs to be studied further since it corresponds with what Giannecchini et al. (2007) noted about the importance of traditional leadership and authority in villages. The chiefs and headman were mentioned many times during the focus groups, which reinforces the authority afforded these traditional leaders by the villagers while simultaneously showing the strength of traditional forms of governance in that villagers turn to headmen for resolution. Giannecchini et al. (2007) further mentioned how a weakening of traditional authority by chiefs and headman was a contributing factor that undermined the resilience of local common pool resources. Importantly, our findings align with theirs, in that headmen appeared to play a dominant though

undetermined role in water management decision making which raises questions about the extent of participatory practices in Hamakuya.

The villagers' understanding of the decision making chain of authority at the local level is muddled, but one interpretation of the data and findings from this study would be to say that the villagers are doing a reasonably good job managing of their water resources in a somewhat decentralized environment. Committee members noted how most all of the villagers know the rules and are happy with the rules about water use. Additionally, there are procedures and penalties in place to correct the action of those few who do not follow the rules. However, another interpretation could conclude that the ability of the villagers to substantially effect change through the participatory mechanisms remains an open question, similar to the findings of Singh et al. (2007) who demonstrated how ineffective communication can hinder trust and limit participatory processes. Likewise, Smith (2011) noted how fragmentation of authority contributed to a diminution in water service delivery and reduced participation in the governing process. Given that this study was about public participation, we concluded that the participatory process in Hamakuya, as it relates to water committees, functions well, but that the credit for that functioning is due to the efforts and coordination of the villagers, and not the decentralized and ambiguous architecture of the federal government as noted by researchers (Nare et al. 2011; Kapfudzaruwa & Sowman 2009; Maldzbender et al. 2005).

Senecah (2004) envisioned ToV as a practical theory that could be used as an active, evaluative metric enabling communities and participants to gauge and potentially improve public participation. ToV allowed us to understand that the

villagers felt that water committees serve a purpose in the village even though understanding the authority and scope of those committees seemed to elude some of the water committee members themselves. The villagers and water committee members were participating but to what end? Are water committees afforded access, standing, and influence with municipal authorities? Additional research (beyond a rapid assessment) using ToV in Hamakuya might shed light on the nature of the working relationship between traditional decision making structures (chief, headman, water committees) and municipal authorities, though Kapfudzaruwa and Sowman (2009) suggest that “there is little evidence to suggest that such partnerships exist or are being formed” (p686). The partnerships that we did see were only those between villagers. The fact that we did not find evidence of partnerships between villagers and the local officials is not evidence that those partnerships do not exist, and is worth further explorations.

Everatt et al. (2010) contend that a point of participatory practices extends beyond adjusting the procedures or expanding the number of participants. A more important goal is that the process is “amenable to being reshaped by participation” (Everatt et al. 2010: 247). During the focus groups the committee members noted how villagers participate in some aspects of the decision making process, but that does not mean that their participation rises to the type of transformative participation mentioned by Everatt et al. (2010). Committee members informed us that the committees play a role in water resource management, but we do not know the legal or statutory foundation and authoritative reach of the committees.

Adaptations to the ToV model might improve the applicability and validity of using this western model of public participation in a non-western environment. For

instance, the element of standing could be expanded to include customs common among rural South Africans that is reflective of the heritage and importance shown for traditional rule. Furthermore, given the importance of traditional leaders in some non-western settings, the model could be expanded to include a fourth element-deference. This deference would not represent a forfeiture of a person's participation in the policy process but signify the cultural importance and mutual responsibility that a leader has to people who choose to follow them. By expanding elements of ToV to take into consideration the unique cultural aspects that are germane to governance in southern Africa are important, and we would build off of the work of Klassen & Feldpausch-Parker (2011), Smith (2011) Merritt (2009) and Senecah (2004). Additionally, this line of inquiry could extend the fit between ToV and other issues that are not well understood.

The projected stress on water resources from climate change, reinforces the need to establish a clearly understood, participatory, and effective water management regime in rural South Africa and is underscored through the findings of Shackleton (2000), Ghetibouo et al. (2010), and The World Bank (2014). Empirically, we may understand that there are multiple and complex drivers contributing to the present and future availability of water in South Africa, but we should not downplay the ability of public participation to serve as one of many important adaptive responses to the projected changes and stress.

Clearly a rapid assessment is not an exhaustive study, but rapid assessments play an important role in the analysis process. Evaluation is a critical step in determining the level and effectiveness of implementation procedures and protocols (Thomas 1993). Additional time in the field and follow up interviews with several

headman and villagers who are not members of the water committee would offer a valuable counterbalance to the perception of the water committee members. The limitations of this study raise additional questions that future members of the IMAGINE research program might choose to address. For instance, future researchers should explore whether and how gender might play a limiting role in public participation. Only one of the interpreters during the 2012 field work was female, so future sampling strategies should plan for the fact that female interpreters might be hard to locate and therefore conducting follow up interviews to test for gender biased answers would be important. The research team believes that home stays serve as a well-intentioned introductory glimpse into cultural life in Hamakuya, but we hold no illusions that the very brief home stays are sufficient to begin to understand the rich cultural history and tradition of village life in Hamakuya. Conducting extended field work of twelve months or more would begin to align more closely with scholars taking an anthropological approach and produce a wealth of contextualized data, but that was not the purpose of this exploratory study and was therefore not selected.

Future researchers should clarify the current and intended participation space for villagers and water committee members in terms of making rules about using water in the villages. Furthermore, researchers should triangulate between villagers, headman, and municipal authorities the extent of responsibilities and limitations of authority of water committees and traditional rulers to make autonomous decisions about water resource management. Despite its limitations, this rapid assessment of public participation in Hamakuya provided meaningful insight into how committee members understand their role in water resource management.

Conducting research in rural South Africa offered a series of challenges and levels of complexity not encountered in a more developed setting. However, as van Kerkhoff (2014) noted, much is gained through complex, integrative research. Since complexity shapes integrative research design and positions the researcher within that complexity instead of attempting to artificially isolate the researcher and control for complexity as is usually the case in conventional research, scholars conducting integrative research stand to benefit from embracing those inherent real-world complexities (van Kerkhoff 2014).

## **Conclusion**

The aim of this case study was to assess of public participation in water governance at the local level in Hamakuya, South Africa. Findings indicated that villagers, water committees, and headman are working collaboratively to manage water resources but not always with clearly demarcated lines of authority. Additionally, the research findings may provide support for the effectiveness of traditional tribal governance approach nested in a larger democratic environment.

This study provided additional insight to the literature related to participatory practices in South Africa (Smith 2011; Booysen 2009; Dressler & Buscher 2008; Lewis & Naidoo 2004) regarding the degree to which the decentralized governance structure as outlined in the NWA is working to include local villagers in the management of their community water resources. This rapid assessment was intended to serve as a starting point for deeper analysis into the participatory and decision-making processes at work in rural South Africa.

Senecah (2004) suggests, “effectiveness in the communication processes by which a community makes its environmental decisions, especially contentious or potentially contentious decisions, is a key component of community sustainability” (p13). Ultimately, by exploring water resource management through tribal experiences, the water committee and the villagers of Hamakuya as well as the various levels of government can begin to understand to what degree water resource management is integrated at the local level.

## **REVALUING VULNERABILITY THROUGH REFLECTIVE RESEARCH**

### **AGENDAS AND EXPLICIT ORIENTATIONS**

Disagreements are occurring in the field of climate change research and policy. One disagreement is about vulnerability and the other is about knowledge. This first disagreement is occurring quietly and primarily between researchers whereby a few scholars and a small segment of the climate change literature suggest that people are vulnerable, not things (Adger 2006; Wisner et al. 2010). The distinction these scholars make is important, because when infrastructure, the economy, roads, or other inanimate objects are labeled vulnerable, we do an injustice to our fellow citizens that have implications for everyone. In chapter 1 it was suggested that if policy-makers and researchers are not mindful, vulnerability to climate change is in danger of becoming reified primarily as a danger to infrastructure and sectors of the economy through computer modeling, scenario building exercises and the institutions supporting these positivist research practices. By following the lead of Adger (2006) and Wisner et al. (2010) we demonstrate linguistic and emotional compassion for people who are legitimately vulnerable, show reflexivity that acknowledges the complexity of climate change vulnerability, and begin to implement a contextualized paradigm for practice that Brunner (2006) considered missing in much of contemporary research and policy.

An equally important, concurrent, yet more public disagreement is going on in the field of climate change surrounding knowledge. Implicit within climate change research and policy is a tension surrounding questions of what types of knowledge and whose knowledge gets included in the decision making process, and that has

important implications for those involved in and affected by climate change. Forsyth (2003) noted the central role that knowledge plays in the policy process stating, “the very definition of who is allowed to be ‘expert’ in framing, measuring, and addressing risks is crucial in determining which knowledge or alternative conceptualizations of problems are accessed” (p182). Ascher et al. (2010) reinforce the power of knowledge and knowledge biases stating, “*who* decides on *what* knowledge is of crucial importance” (p11). The influence of knowledge and whose knowledge is included in decision-making is a central consideration in terms of climate change. This is important because as researchers the way we design the research questions we ask are determinative of the knowledge we create which has decision-making consequences. Since decisions about knowledge shape who or what could be seen as vulnerable (or not) to climate change those decisions have consequences that can shape social vulnerability. Therefore, permitting alternative sources of knowledge to be included in a decision-making process is an important step in acknowledging and addressing social vulnerabilities. Additionally, allowing space for people to define problems (and alternatives) for themselves is an important component of environmental justice along the road to addressing potential social vulnerabilities.

Climate change is inherently complex with an assortment of known and unknown risks (IPCC, 2014), but the difficulties surrounding those conditioning factors do not mean that climate change research and policies should become mired in disciplinary silos, which might limit external knowledge or curtail considerations of environmental justice. Due to its extreme complexity, inherent uncertainties and spectrum of risks, climate change transitions beyond the bounds of applied science and professional consultancy into what Funtowicz and Ravetz (1992) call “post-

normal science” (p254). Funtowicz and Ravetz (1992) suggest that “post normal science” incorporates at least two additional elements beyond those common to applied science and professional consultancy. Those two elements are an “extended peer community” and “extended facts” (p254). In the context of the studies that I conducted on the adaptive action of North Carolina (NC) coastal officials, how small family farmers in Chatham County, NC are experiencing climate change, and public participation regarding water resource management in South Africa, “post-normal science” means that issues and concerns related to climate change extend well beyond the ability of a select few disciplines to resolve. In the context of climate change, the extended community would not only make room for additional scientists from a range of disciplinary backgrounds but would also include concerned citizens with vested interests in an issue as well as the young the old who might express concerns that would otherwise go un-discussed. By including these additional participants and their resources and experiences, a more well-rounded and inclusive discussion of climate change could be had, and the decision space regarding what to address and how to address it would be created thereby addressing social vulnerability.

Given its unknown magnitude and complexity, climate change overwhelms the capacity of traditional decision-making and policy processes of society to find solutions, therefore in many ways we are suffering from a type of “hypocognition” (Lakoff 2010). This condition or “lack of ideas we need” (Lakoff 2010 p76) necessary to communicate climate change means that we as a society are unable to frame the complex and overlapping problems related to climate change, and remain unable to generate effective and acceptable policy solutions. Collectively suffering from this

condition is not surprising given the uncertainties about the causes, timing, effects, and magnitude of climate change compound the variety of risk perspectives related to climate change including actuarial, economic, psychology, social, or cultural perspectives (Krimsky & Golding 1992). This constellation of uncertainty and risk are just some of the factors that functionally push climate change into the domain of “post-normal science” (p254).

By creating an inclusive decision-making process that incorporates an extended community of participants and extended facts, questions of equity and justice are brought into the research equation and policy process (Adger 2006; Schneider & Lane 2006). The idea of exploring elements of equity and justice piqued my pre-existing interest to study questions about procedural and distributive justice that appear lacking in much of the climate change and adaptation literature. Therefore, from that sense of what is lacking in the literature, each of the three case studies I chose in my research either influences or is influenced by a desire to explore social vulnerability to climate change.

Given the disagreements concerning vulnerability and knowledge, during the research design phase it was deemed important to intentionally incorporate and approach each study with a particular rationale in mind, use different conceptual frameworks, include a variety of participants with different knowledge, and use multiple methodologies. As a researcher, being explicit about your assumptions and conceptualizations is important because they form the foundation of your approach and have consequences related to the phenomenon under study. A fundamental assumption about vulnerability underpinning these three studies comes from Wisner et al. (2010), who stated, “vulnerability, as we use the word, refers only to people, not

buildings (susceptible, unsafe), economies (fragile), nor unstable slopes (hazardous) or regions of the earth's surface (hazard-prone)" (p15). With an appreciation for the ability of our ontological and epistemological frameworks to subtly influence the shape and direction of our inquiry, it is important to be explicit about, and investigate the conceptualization of vulnerability that researchers and policy makers bring to their work. My framework of understanding and conceptualizations are provided in Table 5.1 and represent my effort at using multiple methods to contextualize my study of social vulnerability to climate change with location-specific knowledge. By beginning from the research design phase with a commitment to undertake a multi-faceted approach, I sought to embrace the complexity of climate change, create new knowledge, and bring that knowledge into the broader discussion about social vulnerability to climate change. I therefore decided to conduct case studies that looked at the willingness of North Carolina (NC) coastal officials to take adaptive action to climate change; explored how small family farmers in central NC are experiencing climate change; and examined public participation in water resource management decision making in rural South Africa. Each of the three studies either influences or is influenced by social vulnerability to climate change.

The way I designed each of the three case studies allowed me to conduct work that touched on different conceptualizations of vulnerability to climate change found in the literature. Those three conceptualizations are risk-hazard, political economy, and ecological resilience. The risk-hazard approach promotes a technical orientation and rationality to addressing vulnerability to climate change (Eakin & Luers 2006). This orientation takes a short-term view vulnerability, seeing an event as a disruption to an otherwise static environment and assumes that the risks and

resolution are best addressed by a technical risk assessment and the calculated reasoning of properly trained professionals. The political economy conceptualization takes a longer view on vulnerability and considers the availability and access to social, economic, political, and cultural resources as contributing factors that create conditions necessary for vulnerability to exist (Adger & Kelly 1999). The ecological resilience conceptualization takes a much longer view of vulnerability and positions humans as one of many components that interact with natural cycles and forces that fluctuate over time which create conditions that make vulnerability more likely (Eakin & Luers 2006).

Table 5.1 Standpoint clarification and assumptions

	<b>Coastal North Carolina</b>	<b>Chatham County, North Carolina</b>	<b>South Africa</b>
My Dominant Rationality	Technical with cultural aspects	Cultural	Cultural
Framework shaping vulnerability	Risk-Hazard	Access	Political Economy
Participants as	Individuals representing formal institutions	Individuals who are part of a community of small family farmers	Individuals who are members of an informal village board
Method	Quantitative survey based	Qualitative photovoice	Qualitative rapid assessment

Because I am more interested in the underlying assumptions and decisions that might comprise a social value assessment (Schneider & Lane 2006), I am less

interested in the technical risk assessments common to the technical rationality associated with the risk-hazard conceptualization (O'Brien, Eriksen, Nygaard & Schjolden 2007). Unlike technical risk assessments which explore cost-benefit analysis of impacts or computer modeling scenarios regarding the potential for damage to infrastructure or investments, social value assessments ask questions such as “what level of risk is acceptable, and to whom, and what policies are fair for abatement or to compensate losers” (Schneider & Lane 2006 p49). By asking these types of questions, researchers begin to address issues of environmental justice, and it is my hope that my research moves in that direction. My research responds to the tension surrounding vulnerability and disputes about knowledge by adopting an integrative research approach, and a cultural rationality that makes room for both scientific and community knowledge akin to the “post-normal science” (Funtowicz and Ravetz 1992 p254) understanding of climate change. My research suggests that decision-making processes about acceptable levels of risk and directions for policy are situation-specific and should be based on the context of the local participants and corresponding contributing factors.

## **Revisiting Technical and Cultural Rationality**

The cultural rationality mentioned above that informs these three case studies runs counter to the technical rationality that favors logical consistency and expert knowledge, and tends to dominate a great deal of climate change research (O'Brien et al. 2007). A technical formulation might favor a strict scientific perspective of the problem and imply that expert judgment, perspective, and opinion should be given privileged consideration. Conceptualizing vulnerability to climate change as a

technical problem presupposes that people and institutions grounded in scientific knowledge are best suited to address the problems related to climate change.

Furthermore, a corresponding vulnerability associated with climate change from this orientation holds that vulnerability is a result of an event that adversely impacts a community rather than a pre-existing condition that materially contributes to the community being vulnerable. The coastal study was designed and conducted predominantly with technical rationality and a risk-hazard orientation to climate change in mind. Based on that orientation, only the perspective, professional opinion, and cultural rationality of local municipal officials were included in this study (Table 5.1).

On the other-hand, unlike technical rationality, cultural rationality is inclusive of both local knowledge and expert knowledge (Fischer 2000), and aligns with the “post-normal” characteristics of climate change (Funtowicz & Ravetz 1992). Both the Chatham County and the South Africa study were designed and conducted with cultural rationality in mind (Table 5.1). Doing so, allowed me to incorporate those not traditionally included in decision-making processes regarding vulnerability to climate change along with their knowledge and experience. For instance, by asking small family farmers who play a lively and important role in the local sustainable food community in Chatham County and rural villagers in Hamakuya, South Africa about their experiences and impressions in collective decision-making, these two studies privileged the social and cultural knowledge of local citizens above that of technical or scientific experts. By moving beyond a technical rationality of climate change in Chatham County and Hamakuya and by actively seeking out and

integrating the cultural knowledge of these participants, important contextual understandings of social vulnerability were discussed.

According to van Kerkhoff (2014) integrative research requires researchers to exercise reflexivity, or self-reflection, that can run counter to their disciplinary training or assumptions, and to question the traditional linear processes that frequently guide research design. Furthermore, a complexity-based approach toward integrative research “positions the researcher as a participant *within* (emphasis in the original) that complexity rather than a separate observer of it” (van Kerkhoff 2014 p146). From the methodological heterogeneity of the three studies, I demonstrated an attempt to embrace the challenges of conducting integrative research and welcomed the complexity of the issues.

My own research orientation aligns with cultural rationality. This orientation means that even though I appreciate the logic and rigor of technical rationality, my sense is that often times technical rationality and some climate change research fail to incorporate the necessary “contextual orientation” (Fischer 2000 p252) or insights, values, experiences, and judgment that Lasswell (1971) deemed functionally important to research and policy discussions. With that cultural framework in mind as a starting point, the three case studies welcomed an extended community of perspectives that brought alternative sources of knowledge and facts to the study of social vulnerability to climate change.

## **Reflections on the Studies**

All research methods have strengths and weaknesses, and the methods used in these three studies are no different. A discussion of the relative strengths and

weaknesses that emerged from the three studies is provided in this section. There are many ways to manage for strengths and weaknesses associate with research studies, and I preferred to follow the suggestions of Brunner (2006).

Guidelines for researchers wishing to operate within a “paradigm for practice” (Brunner 2006 p135) include seeking “solutions to practical problems or puzzles in particular contexts, not generalization across contexts”; “context-sensitive methods” (p139); and practitioners did not expect “completeness or closure in their understanding” (p141). Researchers who choose to follow the pathway of these three guidelines more easily avoid the pitfalls of reductionism and enable new knowledge to be included in the decision-making process. Additionally, new insights become possible that, in the context of my three case studies, might begin a process of more fully addressing concerns about environmental justice and social vulnerability.

From the Coastal Study I learned that although some NC officials express awareness of climate change, that awareness alone does not necessarily lead to adaptive action. However, when officials felt that climate change posed a threat to their community they expressed considerable willingness to take adaptive action. This is important because it raised the question of whether public officials are exercising community leadership in allowing for adequate time to raise the necessary money and generate the political and community will to prepare and implement plans for climate change. Given that many researchers (Riggs, Culver, Ames, Mallison, Corbett, & Walsh 2008; Strauss, Tebaldi, Kulp, Cutter, Emrich, Rizza, & Yawitz 2014; NC Coastal Resources Commission 2015) warn that sections of the NC coast stand to be significantly impacted by climate change, it is somewhat disconcerting how several coastal officials expressed doubt over the accuracy and

legitimacy of information and data surrounding climate change. Interestingly though, that doubt presents an opportunity to conduct future research into the role of values and beliefs of coastal officials, and how those values might shape willingness to take adaptive action. This study marks one of a significant few efforts to document the willingness of NC coastal officials to take adaptive action in the context of climate change. Furthermore, by examining adaptation as part of a network of solutions to the practical problems associated with climate change, yet not expecting to completely understand the complexities and nuances facing these coastal communities, this study embraced Brunner's (2006) call for a "paradigm for practice."

A strength of this study is that it sampled a wide variety of coastal officials from all twenty coastal counties in NC. The online survey allowed me to gain data from municipal officials beyond mayors and city managers, to include environmental specialists, planners, geographic information specialists, and public health professionals. The open-ended question on the survey provided the respondents with an opportunity to express concerns related to climate change that were not limited by the construction of the other survey questions; important qualitative data were gained this way. Additional data were gathered from the respondents including proximity to waterfront property, years in current profession and position, and data about the sources of news and information about climate change that officials prefer that were not included in the coastal chapter. Analysis and findings related to that data will form the basis of future papers.

Conducting asset mapping exercises or focus groups (methods used in the other studies) with coastal officials would have been significantly more difficult,

resource intensive, and time consuming but could have produced information about social or cultural resources that officials feel are especially threatened by climate change and worth protecting. A photovoice project with coastal officials is an intriguing idea that might have shown the enormity of information, concerns, and limitations that coastal officials attempt to reconcile on a daily basis. Comparing those different perceptions about vulnerability and concerns among officials might have expressed patterns of similarity or dissimilarity regarding vulnerability along the NC coast. From those comparisons across communities and similarly held positions, a voice might have emerged which simultaneously questions the potential of climate change impacts to the NC coast while calling for new or additional sources of information so that officials may protect the people and resources of their communities. However, conducting a photovoice study that explored the same population of interest across all twenty coastal counties would be beyond the skills and abilities of any one researcher to conduct and conclude in a reasonable time frame, and in other ways would represent a misunderstanding or misuse of photovoice. Because photovoice is grounded in empowerment education, documentary photography, and feminist theory the method emphasizes shifting “control over representation and knowledge generation from those in positions of power to those whose perspectives are seldom seen or heard (Lopez, Eng, Robinson, & Wang 2013, 492), and it might be argued that municipal officials possess power and that other methods outside of photovoice could accurately capture their perspective. Completing such an unprecedented and comprehensive undertaking would necessitate a team of researchers a number of years to complete. During the coastal study I did not conduct in-depth interviews with officials, which could have

provided additional qualitative data that probed the online survey responses. Additionally, data were not collected documenting previous climatological patterns or future modeling scenarios related to each and every community along the coast that could have then been compared with like communities along the NC coast. One reason why that type of study was not done is because I remain more interested in assuming a cultural rationality to exploring climate change rather than the type of technical risk assessments that so many in academia rely and feel more comfortable discussing.

During the Chatham County study I fully embraced the “extended peer community” and “extended facts” that Funtowicz and Ravetz (1992) outlined, and in doing so revealed a richness of experience tied to one particular place. By collaborating with the small family farmers, I was not only able to investigate how climate change was impacting small family farming in Chatham County, but also discuss their perspectives and relationships with farming as an identity while co-creating important new knowledge. What is most significant about this study is its contextual depth. Photovoice allowed me to access the lived experience of small family farmers in central NC and document their unique perspectives in terms of farming with climate changes similar to the cultural rationality approach of Brugger and Crimmins (2013) in a way that other methods would not have been able to. This study created context-sensitive knowledge about changes occurring across farms in Chatham County and the adaptive strategies that the farmers are using in an attempt to bolster their resilience. By grounding this study in photovoice, a method sensitive to communities, I worked with farmers to understand the practical problem of farming in the context of a changing climate in this one particular county instead of

attempting to generalize more broadly, thereby aligning with Brunner's (2006) call for a "paradigm for practice."

By taking such a qualitatively focused approach that turned over data collection to the small family farmers, I forsook collecting quantitative data that might have demonstrated different patterns of change. If another researcher had decided to take a technical rational approach they might have concentrated on collecting precise precipitation patterns for an extended period of time by trained professionals, or asked for data regarding changes in crop yield for a number of years, asked for data about soil conditions or sought out comparative farming communities that could provide similar quantitative data. Not collecting these types of data from the farmers made it impossible to compare technical data in university or government meteorological databases. Similarly, others might suggest that survey data would have allowed for comparison across a spectrum of sizes and types farming operations, or those who prefer to run inferential test of analysis might wish for data regarding the political orientation of the farmers to see if ideology played a role in how farmers experience climate change. By not gathering those types of data, the generalizability of the study is open to question by those adhering to a technical rational frame of reference.

A broad lesson from the Hamakuya study was how traditional forms of governance appeared to be functioning well in rural South Africa, which aligns with the findings of Nare, Odiyo, Francis, & Potgieter (2011). Additionally, these traditional forms of decentralized governance should be considered viable and legitimate alternatives alongside the more conventional western institutions of governance. Conducting a rapid assessment in rural South Africa allowed me to

begin understanding the complexity of assessing public participation from a western perspective in a nonwestern environment. There is reciprocating value in conducting such research, because the findings not only provide insight into the participatory experience of the community of inquiry but also generates a reflective pause whereby the researcher can compare findings to their own participatory experiences. Despite limited time in Hamakuya, the language and cultural barriers, and the participation barriers that sprang up when government subsidies were being distributed the day of our focus groups, the study generated ample data, achieved our limited project goals, and situated the research team “within the complexity” (van Kerkhoff 2014 p146) of the research topic. By designing and situating this case study as we did, the findings approached the type of contextual understanding that noted Adger’s (1999) research regarding social vulnerability of fishing villages in Vietnam. Generating a contextual understanding of village life and experience are important factors in a broader effort to understand social vulnerability of rural communities.

This study built on previous research that suggested a need to further investigate the role of water committees while revealing a complex relationship between traditional, tribal governance regimes and conventional western constitutional reforms introduced to South Africa. The interaction between these two governance structures that are operating side-by-side may need to be revisited in light of cultural expectations and practices regarding public participation as it takes place in village life. The rapid assessment was appropriate method for this study because it provided us with the perspective of water committee members that we sought, but it also showed us that we needed to explore the role of headmen in terms of decisions about water resource management. Knowledge was gained documenting

a functioning system of local water resource management. However, as Brunner (2006) cautioned, although our assessment of participation addresses an issue of practical importance our understanding of the participation processes does not represent a complete understanding within this cultural context. The study does, however, represent an important evaluative step in determining the participatory experience and process of rural water management decision making in the context of climate change.

Because a rapid assessment was used, the amount of data gathered was necessarily limited. A traditional survey aligned with technical rationality would have focused on generating quantitative data from the villagers and water committee members regarding the number and frequency of public participation occurrences. From survey data we might have learned the extent of villagers who participate in decision-making or uncovered what headmen understand their role in water resource management decision-making is. A photovoice study would have delved into the lived experiences of villagers in Hamakuya showing both the strengths and weaknesses of participatory practices as they exist, and conducting such a study remains a real possibility for future research. With additional time in the field we could have conducted interviews with local officials and compared those responses with those from the water committees and the headmen. We could have also looked at public participation and decision-making practices in other villages to see how they might compare with those documented in Hamakuya. Not having that other data means that the participation and decision making practices we found in Hamakuya are less generalizable to other areas in rural South Africa, and we are unable to run statistical tests of analysis.

Across the three studies, there is a consistent effort to be explicit about my standpoint and assumptions, and use multiple methodologies that align with Brunner's (2006) "paradigm for practice" (p245), which is designed to foster new knowledge, practical solutions through context-approach methods to the study issues of importance. However, I remain mindful and strive to exercise the reflexivity called for by van Kerhoff (2014), Brunner (2006), and Fischer (2000) and understand that maintaining a paradigm for practice is a process that requires continuous attention and correction of practices and assumptions rather than merely a one-time adjustment. To operationalize this paradigm in future research, I would decide to study an issue from a variety of frameworks and orientations, instead of a variety of issues from one framework. Instead of defaulting to our ordinary and comfortable research perspectives, researchers might consider conducting repeated studies of the same issue but with different colleagues and with different assumptions. Through the repetition and various research orientations, a deeper understanding of an issue like social vulnerability may be gained.

## **Concluding Thoughts**

Based on what I have learned about social vulnerability to climate change, my next steps center around establishing a research agenda that is focused on conducting a popular epidemiology-inspired analysis of vulnerability to climate change (Eng & Parker 1994; Corburn 2005). While the connection between public health, environmental conditions, and vulnerability are codified in the Environmental Protection Agency's Environmental Justice program (EPA 2014), climate change stands to exacerbate existing weaknesses. This research agenda

would resemble popular epidemiological effort in that it marks a collaborative approach to examine the nature and incidence of social vulnerability, the distribution of social vulnerability across communities, and the potential control or management of factors contributing to social vulnerability through adaptive action. The use of particular metrics of social vulnerability would vary depending of the context of the community of study. This popular epidemiology-inspired analysis of vulnerability to climate change would seek partners in the fields of public health and environmental justice community such as Majora Carter or leverage the work of Corburn (2005) who demonstrated the power of “street science” (p28) to address environmental and community health issues. Furthermore, by partnering with and leveraging the knowledge of community members and leaders as well as experts from academia, this effort would be grounded in cultural rationality and include the multiple “extended peer community” and “extended facts” mentioned by Funtowicz and Ravetz (1992). Through that research agenda a network of knowledge regarding social vulnerability to climate change would be created and serve to contextualize our understanding of vulnerability to climate change that involves scientific knowledge along with traditional knowledge and location-specific knowledge.

Popular epidemiology emerged as a bottom-up approach in the field of public health and marked a divergence from the traditional ways in which public health research had been conducted in communities (Eng & Parker 1994). This new approach denoted a community-driven collaborative effort between public health researchers and concerned citizens who worked together to explore and document environmental health risks commonly through community health surveys (Fischer

2000). I envision creating a similarly styled effort centered on social vulnerability to climate change and adaptation.

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## **APPENDICES**

## APPENDIX A. COASTAL STUDY SURVEY INSTRUMENT

The purpose of the survey is to gain an understanding of how officials in Eastern North Carolina decide whether or not to allocate resources for adaptive action regarding issues related to climate change. Examples of resources could include educational programs, economic initiatives such as direct financial allocations creating of new staff/research positions, funding studies, creating cross-jurisdictional partnerships, drafting regulatory measures, etc.

This survey is a very important part of my research as a Ph.D. student at North Carolina State University. There are less than 25 questions in the survey and should take you less than 15 minutes to complete. Your time and patience in completing this survey is greatly appreciated. Your responses will be confidential, and reported in aggregate only. If you have questions or concerns about the survey please contact me at [brbulla@ncsu.edu](mailto:brbulla@ncsu.edu).

Thank you very much for sharing your expertise and opinions!

1. What is your profession/title?
  - a. {open text box}
2. Number of years employed in your *current profession*. Please round down to nearest whole number [drop down box]
3. Number of years employed in your *current position*. Please round down to nearest whole number [drop down box]
4. Zip Code of your office \_\_\_\_\_.
5. Please estimate **what percentage** of the residents in your county live directly on waterfront property (lake, intercostal water way, ocean, river, sound) For example, 2%, 10%, 25%, 33%, 50%, etc. \_\_\_\_\_.
6. What are your top three (3) sources for general news: please select from the list in the drop down box. (Friends, Family, Local newspaper, Regional newspaper, Local television station, Regional television station, ABC World News, CBS Evening News, CNN Headline News, Fox News, Frontline, Google News, Huffington Post, MSNBC, New York Times, NPR, PBS News Hour, Reuters, USA Today, Wall Street Journal, Washington Post, other) [drop down box].
7. **As a community official**, in general, how trustworthy do you feel each of the following are in terms of providing credible information about climate

change on a scale of 1 to 5? (1 = Do not Trust; 2 = Rarely Trust; 3 = Occasionally Trust; 4 = Usually Trust, 5 = Completely Trust)

- a. Newspapers \_\_\_\_\_
- b. Television \_\_\_\_\_
- c. Talk radio \_\_\_\_\_
- d. University researchers \_\_\_\_\_
- e. Local Government officials \_\_\_\_\_
- f. State Government officials \_\_\_\_\_
- g. Federal Government officials \_\_\_\_\_

8. **As a community official**, how knowledgeable do you feel you are about climate change? Please check one.

- a. Not at all informed
- b. Slightly informed
- c. Neutral or neither informed nor misinformed
- d. Moderately well informed
- e. Very well informed
- f. Don't know

Please indicate your level of agreement with the statement by selecting the response most relevant to you.

9. **As a community official**, I feel that my community will face threats or issues from climate change.

- a. Strongly Disagree
- b. Disagree
- c. Neutral or neither disagree nor agree
- d. Agree
- e. Strongly Agree

\*\* [If Strongly Disagree, Disagree, or Neutral move to next question #10]

\*If Agree or Strongly Agree, then respondents are taken to a sub-question asking: What do you feel are the top three (3) threats or issues facing your community from climate change. {open ended/fill in the box}

Please indicate your level of agreement with the next three (3) statements by selecting the response most relevant to you as an individual citizen.

10. **As a community official**, I feel climate change will have a noticeably negative impact on the health of my community in the next 25 years.

- a. Strongly Disagree
- b. Disagree
- c. Neither disagree nor agree

- d. Agree
  - e. Strongly Agree
  - f. Don't know
11. **As a community official**, I feel climate change will have a noticeably negative impact on *the economic and financial condition of my community* in the next 25 years.
- a. Strongly Disagree
  - b. Disagree
  - c. Neither disagree nor agree
  - d. Agree
  - e. Strongly Agree
  - f. Don't know
12. **As a community official**, I feel climate change will have a noticeably negative impact on the *environment of my community* over the next 25 years.
- a. Strongly Disagree
  - b. Disagree
  - c. Neither disagree nor agree
  - d. Agree
  - e. Strongly Agree
  - f. Don't know

The following five (5) statements deal with various hypothetical climate change scenarios. Please answer after considering **how likely you would be, as a community official, to commit resources** to take adaptive action under each scenario. Examples of resources could include educational programs, economic initiatives such as direct financial allocations creating of new staff/research positions, funding studies, creating cross-jurisdictional partnerships, drafting regulatory measures, etc.

13. Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces a **low** level of risk or vulnerability from climate change...*given this scenario how likely would you, as a community official, be to commit resources to take adaptive actions?*
- a. Extremely unlikely
  - b. Somewhat unlikely
  - c. Neither likely nor unlikely
  - d. Somewhat likely
  - e. Extremely likely
  - f. Don't know
14. Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces an **average** level of risk or vulnerability from climate change...*given this scenario how*

*likely would you, as a community official, be to commit resources to take adaptive actions?*

- a. Extremely unlikely
- b. Somewhat unlikely
- c. Neither likely nor unlikely
- d. Somewhat likely
- e. Extremely likely
- f. Don't know

15. Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces a **higher than average** level of risk or vulnerability from climate change...*given this scenario how likely would you, as a community official, be to take commit resources to adaptive actions?*

- a. Extremely unlikely
- b. Somewhat unlikely
- c. Neither likely nor unlikely
- d. Somewhat likely
- e. Extremely likely
- f. Don't know

16. Independent scientists, researchers, and bi-partisan government officials have concluded and agree that in the future your community faces a **very-high** level of risk or vulnerability from climate change...*given this scenario how likely would you, as a community official, be to take commit resources to adaptive actions?*

- a. Extremely unlikely
- b. Somewhat unlikely
- c. Neither likely nor unlikely
- d. Somewhat likely
- e. Extremely likely
- f. Don't know

17. Independent scientists, researchers, and bi-partisan government officials have concluded and agree that your community faces an **uncertain** level of risk or vulnerability from climate change...*given this scenario how likely would you, as a community official, be to commit resources to take adaptive actions?*

- a. Extremely unlikely
- b. Somewhat unlikely
- c. Neither likely nor unlikely
- d. Somewhat likely
- e. Extremely likely
- f. Don't know

18. Do you have additional thoughts that you would like to share regarding information or decision-making about climate change in your county/community?

- {open text box}

19. Gender (please check one)

Male Female

20. In what year were you born \_\_\_\_\_?

21. What is your highest level of education completed? Please check one.

- High school
- Associate's or Technical Degree
- Bachelor's Degree
- Masters/Ph.D.
- Medical Degree or Juris Doctor

22. What is your Political Party Affiliation (please check one)

- Democratic
- Independent
- Republican
- Other-unaffiliated
- Do not wish to answer
- Do not know

23. Political Ideology (please check one that most closely aligns with *your personal philosophy of government*)

- Very Liberal
- Liberal
- Moderate
- Conservative
- Very Conservative
- Libertarian

## APPENDIX B. CODEBOOK FOR COASTAL NORTH CAROLINA

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
SLR		SLR1.0	Apply this code when participants talk about sea level rise	Topical
Air		A1.0	Apply this code when participants talk about potential changes in air quality or temperature	Topical
Drinking Water		DW1.0	Apply this code when participants talk about potential changes in water quality or temperature	Topical
Precipitation		P1.0	Apply this code when participants talk about precipitation in general terms	Topical
	Precip./Erosion	PE1.0	Apply this code when participants talk about potential damage from erosion	Sub-topical
	Precip./Flood	PF1.1	Apply this code when participants talk about potential damage from flooding	Sub-topical
	Precip./Frequency-Intensity	PFR1.2	Apply this code when participants talk about the potential for more frequent or intense precipitation events or patterns	Sub-topical
	<i>Storm Water Mgt.</i>	<i>PSWI1.3</i>	<i>Apply this code when participants talk about potential damage from storm water or need for storm water management</i>	<i>Sub-topical</i>

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
Natural Resources		NR1.0	Apply this code when participants talk generally about the possibility of impacts to natural resources	Topical
	Agriculture/Crop	NR1.1	Apply this code when participants talk about potential impacts to agriculture	Sub-topical
	Wetlands	NR1.2	Apply this code when participants talk about potential impacts to wetlands	Sub-topical
	Coastal Habitat	NR1.3	Apply this code when participants talk about potential impacts to coastal habitats	Sub-topical
Infrastructure		Infr1.0	Apply this code when participants talk about potential damage to infrastructure	Topical
Barrier Islands		BI1.0	Apply this code when participants talk about the possibility of losing barrier islands	Topical
	<i>Loss of Beachfront property</i>	<i>BI1.1</i>	<i>Apply this code when participants talk about the possibility of losing beachfront properties</i>	<i>Sub-topical</i>
Economic		E1.0	Apply this code when participants talk about economic impacts in general terms	Topical
	Econ/Tourism	ET1.0	Apply this code when participants talk about the potential impacts to the tourism industry	Sub-topical
	Econ/Fishing	ET1.1	Apply this code when participants talk about potential impacts to the fishing industry	Sub-topical

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
<i>Weather Patterns</i>		<i>WP.1.0</i>	<i>Apply this code when participants talk about general changes in future weather patterns</i>	<i>Topical</i>
<i>Education / Information</i>		<i>ED.1.0</i>	<i>Apply this code when participants talk about the need to get accurate information and being educated about climate changes</i>	<i>Topical</i>
<i>Public Health</i>		<i>PE.1.0</i>	<i>Apply this code when participants talk about issues related to public health and disease</i>	<i>Topical</i>
<i>Capacity</i>		<i>CAP.1.0</i>	<i>Apply this code when participants mention that local governments need to increase their capacity to handle climate change</i>	<i>Topical</i>
1. * Water Availability 2. * Acidification 3. * Altered Ocean and Atmospheric Circulation Patterns				

\*Mentioned in the literature but not included in this codebook because they were not mentioned by participants.

\*Italicized codes are for issues mentioned by the participants but not specifically listed as a code in the four resources mentioned below.

The codes included in this codebook were largely synthesized from four different, but equally relevant resources pertaining to coastal climate change issues. The report from EcoAdapt is specifically about adaptation in marine and coastal environments. Both the EPA and NCA resources are federal efforts designed to highlight the regionally specific impacts of climate change across the US. The Riggs et al. white paper takes an in-depth look at potential impacts of climate change to the coast of North Carolina.

- Gregg, R., Hansen, L., Feifel, K., Hitt, J., Kershner, J., Score, A., and Hoffman, J. (2011) The state of marine and coastal adaptation in North America: a synthesis of emerging ideas (report). EdoAdapt.

- Environmental Protection Agency, Climate Impacts in the Southeast ~  
<http://www.epa.gov/climatechange/impacts-adaptation/southeast.html>
- National Climate Assessment, 2014. Climate Change Impacts in the United States ~  
<http://nca2014.globalchange.gov/node/9495>
- Riggs, S., Culver, S., Ames, D., Mallison, D., Corbett, D., & Walsh, J. (2008). North Carolina's coast in crisis: A vision for the future. Department of Geological Sciences, East Carolina University, Greenville, N.C.

## APPENDIX C. CODEBOOK FOR PHOTOVOICE STUDY

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
Rain		R1.0	Apply this code when participants mention issues about rain or other precipitation	Topical
	Flooding problems	R1.1	Apply this code when participants talk about flooding problems	Sub-Topical
	Erosion	R1.2	Apply this code when participants talk about erosion problems	Sub-Topical
	Frequency or intensity of rain	R1.3	Apply this code when participants talk about the intensity or frequency of rain events	Sub-Topical
Change		Ch1.0	Apply this code when participants talk about how <i>things</i> have changed	Topical
	Noticing changes	Ch1.1	Apply this code when participants talk about how they are noticing changes in the weather or around their farm	Sub-Topical
	Adjusting to changes	Ch1.2	Apply this code when participants talk about how they are adjusting to changes	Sub-Topical
	Feelings/Attitudes about changes	Ch1.3	Apply this code when participants talk about how they are feelings about adjusting to changes	Sub-Topical
	Symptoms of broader change	Ch1.4	Apply this code when participants talk about how they see changes to the larger ecosystem	Sub-Topical
	Behavioral response to change	Ch1.5	Apply this code when participants talk about how they are responding to the changes they see	Sub-Topical

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
Crops		C1.0	Apply this code when participants mention issues related to their crops	Topical
	Diversity of crops grown	C1.1	Apply this code when participants talk about how diverse (or not) the composition of their crops are	Sub-Topical
	Crop or animal response to change	C1.2	Apply this code when participants talk about how their crops or animals are adapting/responding to changes	Sub-Topical
Viability		V1.0	Apply this code when participants discuss the viability of their farming	Topical
	Expenses related to maintaining their viability	V1.1	Apply this code when participants talk about the expenses related to their adaptive efforts	Sub-Topical
	Different markets or customers	V1.2	Apply this code when participants talk about their customer base or target market	Sub-Topical
Positive-Change (benefits)		PC1.0	Apply this code when participants mention positive changes they are seeing	Topical
	Do not need to irrigate	PC1.1	Apply this code when participants talk about how they do not have to irrigate	Sub-Topical
	Bumper crop production	PC1.2	Apply this code when participants talk about how well their crop-crop production is doing	Sub-Topical
	Unanticipated food options or reduced stress on crops	PC1.3	Apply this code when participants talk about how some changes are temporarily relieving some crop/animal stress	Sub-Topical

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
Resilience		RES1.0	Apply this code when participants discuss resiliency	Topical
	General Adaptability to climate change	RES1.1	Apply this code when participants discuss adapting to climate change	Sub-Topical
	Storable crops	RES1.2	Apply this code when participants talk about how storable crops help them	Sub-Topical
	Seed Banks or Seed Sharing	RES1.3	Apply this code when participants talk about saving or sharing seeds	Sub-Topical
	Experimenting with polycultures and shade	RES1.4	Apply this code when participants talk about how they are building resilience through the use of shade or polyculture	Sub-Topical
	Control and cultivating flexibility	RES1.5	Apply this code when participants talk about how they need to remember their place in the larger system and relinquish a need for control	Sub-Topical
Vulnerability		Vul1.0	Apply this code when participants mention vulnerability	Topical
	Risks	Vul1.1	Apply this code when participants talk about risks they encounter	Sub-Topical
	Temperature or heat vulnerability	Vul1.2	Apply this code when participants talk about how temperature changes can effect their farming operations	Sub-Topical

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
Community		COM1.0	Apply this code when participants mention community	Topical
	Connections and relationships	COM1.1	Apply this code when participants talk about connections they have and why they are important	Sub-Topical
	Knowledge and awareness	COM1.2	Apply this code when participants talk about building, sharing, or the importance of their knowledge	Sub-Topical
	Trust	COM1.3	Apply this code when participants talk about building, sharing, or the importance of trust	Sub-Topical
	Support	COM1.4	Apply this code when participants talk about the presence or absence of support for them in the community	Sub-Topical

<b>Code Name</b>	<b>Sub-Code Name</b>	<b>Code ID</b>	<b>Decision Rules</b>	<b>Code Type</b>
Challenges		CHaL1.0	Apply this code when participants mention challenges	Topical
	Expenses: time, money, or equipment	CHaL1.1	Apply this code when participants talk about how time, money, or equipment can be challenges for their practices	Sub-Topical
	Invasive species	CHaL1.2	Apply this code when participants talk about the presence of invasive species	Sub-Topical
	Pest	CHaL1.3	Apply this code when participants talk about issues related to the presence or absence of pests (gnats, ticks, fire ants, deer, beetles, bugs)	Sub-Topical
	Multiple roles to play	CHaL1.4	Apply this code when participants talk about how they have to play and manage several different roles as a farmer	Sub-Topical
	Sacrifices	CHaL1.5	Apply this code when participants talk about the variety of sacrifices they make and how they manage	Sub-Topical
Farming		F1.0	Apply this code when participants mention why they farm	Topical