BARRIERS AND ENABLERS TO CLIMATE AND HEALTH ADAPTATION PLANNING IN RURAL, COASTAL COUNTIES IN MICHIGAN

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ABSTRACT

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Authorities have declared that the implementation of adaptation strategies is necessary to protect current and future generations from the public health impacts of climate change (IPCC, 2018; US EPA, 2018; USGCRP, 2018). Yet not all communities have begun to plan for climate change, nor implement adaptation (Rosina Bierbaum et al., 2013a). Current adaptation literature focuses heavily on urban areas, developing countries, and agricultural practices. Nonagricultural-dependent rural areas, accounting for over 80% of the nonmetro counties in the United States (USDA ERS, 2015), are largely unexplored.

Through a qualitative, exploratory, mixed-methods approach, surveys and interviews are used in this study to examine the barriers and enablers to climate and health adaptation in nonagricultural-based rural, coastal Marquette County in Michigan. Relatively advanced in climate adaptation planning, the study area represents a rural county actively addressing climate and health concerns. The findings support other researchers while identifying barriers and enablers unique to nonagricultural-based rural, coastal areas. This study broadens the current understanding of the challenges and opportunities faced in approaching adaptation, in hopes of ultimately better preparing communities for the negative health impacts of climate change.

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Chapter 1. Introduction

1.1 Background

Although the scientific understanding of climate change is under continuously evolving research, the overwhelming current day consensus is that the earth's climate is changing beyond normal climate variations, the effects of which pose health risks to humans globally (CDC, 2018). Internationally, the effects of climate change are affecting ecosystems and endangering human health through temperature changes and rising sea levels, among other impacts (UNEP, 2018b). In the United States, recent extreme events outside of the norm such as destructive wildfires and unprecedented damaging patterns of hurricanes have made obvious American's vulnerabilities to the impacts of climate change (NOAA, 2018; NOAA NCEI, 2018). The United Nations Environment Programme (UNEP) states that mitigating the effects of climate change through reducing carbon emissions is no longer sufficient for preventing the impacts of climate change and that adaptation measures must also be enacted in order to prepare for and protect human lives from some of the dangerous impacts of global warming (UNEP, 2018).

Beyond the health risks posed on current and future residents of the planet, the recently released Fourth National Climate Assessment from the U.S. government's Global Change Research Program reiterated other negative impacts of climate change on the United States, raising the alarm in the media. The November 2018 Report outlines current damages and expectations for the future of U.S. communities, economy, water, health, ecosystems and ecosystem services, ways of life, agricultural security, infrastructure, impacts on oceans and coast, impacts on tourism and recreation, among other things (USGCRP, 2018). The interconnectedness of impacts, international effects, current experiences, and the hundreds of billions of dollars in economic costs of inaction especially caught international news headline attention in 2018, as did the importance of adaptation action (McGrath, 2018; Plumer, 2018; Plumer & Foutain, 2018).

While everyone's health is at risk by changes to food and water supply, air quality, extreme weather, the spread of infectious disease and more, certain populations such as children, the elderly, the sick, the poor, and some minority communities are more vulnerable than others (CDC, 2018a). Certain sites such as brownfield sites, waste management facilities, and energy plants pose particular risks during extreme events. Areas with high rates of vulnerable populations or high-risk sites, including rural areas, will be particularly impacted by climate change, as their ability to respond is relatively diminished (USGCRP, 2018). Rural areas in particular have been identified as at higher risk to negative climate impacts due to their relatively long list of disadvantages including physical isolation, high poverty rates, and aging populations (Lal, Alavalapati, & Mercer, 2011; USGCRP, 2018). According to the United States Global Change Research Program's Fourth National Climate Assessment, the United Nations Intergovernmental Panel on Climate Change (IPCC), the United States Environmental Protection Agency, and other authorities, climate change adaptation strategies are necessary to protect current and future generations from the worst effects of climate change (IPCC, 2018; US EPA, 2018; USGCRP, 2018).

As climate change becomes more evident in daily life and reports alerting the public to impending dangers more regular, adaptation continuously becomes a more concrete part of the local planning conversation. Research and literature at all levels have begun to explore adaptation through numerous lenses, from strategy effectiveness to vulnerable populations to policy development and more. One approach research has taken is to seek to understand what acts as barriers or enabler for adaptation planning by communities. Research across contexts has found the list of barriers has been noted to be "potentially endless" (Biesbroek, Klostermann, Termeer, & Kabat, 2013) and highly contextual (Eisenack et al., 2014).

1.2 Need for research

Most existing adaptation research focuses on urban areas and largely overlooks coastal, rural, resource-constricted community needs. Of research on rural climate change adaptation planning, most has taken place in developing countries and is centered around agriculture (e.g. Singh et al., 2018; Chaudhury et al., 2017). Within the United States as well, almost all rural adaptation research focuses on protecting the agricultural industry (e.g. The Fourth National Climate Assessment, USGCRP, 2018). While some research has occurred in small coastal communities (e.g. Crawford et al., 2018; E. M. Hamin, Gurran, & Emlinger, 2014), the research has largely failed to address the climate and health needs of non-agricultural based, coastal and rural communities (Dasgupta et al., 2014; Wood et al., 2014). While agriculture is obviously significant, nonagricultural-based communities make up over 80% of nonmetro counties (USDA ERS, 2015) and face climate impacts beyond the detriment of farming. Some of these risks include aging and at risk communication, transportation, water, and sanitary infrastructure (USGCRP, 2018), as well as reduced access, isolation, limited medical facilities, and limited emergency services, among other things (Houghton et al., 2017).

Additionally, rural areas have been identified as one of the locations to be hardest hit by climate change due to high rates of vulnerable populations and limited adaptive capacity (USGCRP, 2018). Nonagricultural rural areas face climate impacts such as increased temperatures, flooding, wildfires, drought, wetland loss, heat waves, and extreme events, as well as impacts to economic livelihoods (Angel et al., 2018; Gowda et al., 2018). Specifically Great Lakes coastal areas face increased water temperatures, decreased ice cover, increased storm severity, coastal erosion, flooding, drought and other negative impacts (Angel et al., 2018; Fleming, 2018). All of these climate impacts have related health concerns including increased vector habitats, water contamination, water scarcity, damaged infrastructure, poor air quality days, extended pollen seasons, and mental health stressors (Angel et al.,

2018). Exacerbating these concerns are prevalent and ongoing issues such as limited code enforcement (Rosser, 2006), high poverty rates, economic/social resource-dependence, an aging population, physical isolation, lower income levels, lack of jobs, limited access to the internet, minimum political sway, and limited community resources further limit capacity to address climate changes (Lal et al., 2011; USGCRP, 2018). Rural counties have been found to face a "climate gap", defined as "the disproportionate and unequal impact the climate crisis has on people of color and the poor" (Morello-Frosch et al., 2009).

With 15% of the U.S. population living in rural areas, nearly 40% of the population living in counties adjacent to a shore (Kildow, Colgan, Johnston, Scorse, & Farnum, 2016), and over 80% of the "nonmetro" counties in the United States with industry bases other than agriculture (USDA ERS, 2015), the climate health impacts, vulnerabilities, and adaptation strategies for these areas cannot be ignored (USGCRP, 2018). Significant non-climate stressors compound with climate change to increase a rural population's health vulnerability to climate change. While some see urbanization as an adaptive measure to climate change (Calthorpe, 2010), rural lifestyles provide choice and at times can be considered more self-reliant and sustainable than urban dwelling. A recognition that rural communities provide the basic necessities of life (food, fresh water) for cities and that their residents are the "stewards" (Gowda et al., 2018) of the world's natural resources makes an understanding of climate change adaptation in these areas vital. Indeed, the 2018 Fourth National Climate Assessment calls specifically on social science researchers to "improve understanding of the vulnerability of rural communities, strategies to enhance adaptive capacity and resilience, and barriers to adoption of new strategies" (Gowda et al., 2018). This study addresses the nonagricultural rural research gap by examining the enablers and barriers to climate and health adaptation planning and plan implementation in a rural, coastal community in Michigan.

1.3 Purpose and objectives

The primary purpose of this research is to qualitatively explore the barriers and enablers to climate and health planning in a rural, coastal county in Michigan. The study aims to use surveys and interviews to expand the existing literature on climate change adaptation planning to climate and health adaptation in a rural, coastal setting in the United States. Specifically, the objectives of this study are to 1) use a survey to identify the barriers and enablers to climate and health planning in Marquette County, Michigan; 2) conduct interviews to explore the details of the barriers and enablers to climate and health planning in Marquette County, Michigan; and 3) identify how the barriers and enablers of climate and health planning in Marquette County, Michigan reflect or diverge from existing literature on barriers and enablers to climate planning, which mainly focuses on urban and agricultural areas. Ultimately, the research strives to add to the current literature to build the knowledge base necessary for urban planners and other public officials to better prepare all communities for the negative health impacts of climate change.

1.4 Research Questions

To identify the barriers and enablers to climate and health adaptation planning in a nonagricultural, rural, coastal context, two straightforward research questions were asked:

1. What are the barriers to climate and health adaptation planning in rural, coastal Michigan?
2. What are the enablers to climate and health adaptation planning in rural, coastal Michigan?

1.5 Study Design and Context

To answer the research questions, a qualitative, mixed-methods approach was adopted. A survey of public officials was used to identify the overall barriers and enablers to climate and health adaptation

within the study area. Follow up interviews of select participants explored the details of the barriers and enablers by individuals working within the study area.

The study explored the topic in the study site of the geographically-large, relatively-remote, nonagricultural, rural, coastal county of Marquette, Michigan. Michigan contains 57 'nonmetro' counties (USDA ERS, 2018) and currently 39 communities in Michigan are either in the process of adopting or have adopted Climate Action, Resiliency, and/or Sustainability Plans (Karner, 2018). Relatively advanced in adaptation planning, Marquette County has a county-wide task force addressing the concern and has been actively planning for adaptation since 2011. As part of an ongoing project through the Centers for Disease Control and Protection (CDC) Climate Ready States and Cities Initiative (CRSCI) with the Michigan Department of Health and Human Services, in 2017 Marquette County expanded their adaptation efforts and began planning for climate and health. Through these efforts, Marquette County represents a rural, coastal county actively addressing adaptation through planning.

1.6 Significance of study

The urgency of planning for climate change coupled with the glaring gap in the of adaptation needs of rural areas presents a clear significance for this study. This research expands the scope of the limited literature on climate and health adaptation planning in coastal, rural areas by exploring the barriers and enablers to climate and health adaptation planning in a rural, coastal county in Michigan. With 57 of 83 counties in Michigan designated as "nonmetro" by the United States Department of Agriculture (USDA) (RUPRI, 2006), at a minimum this study can begin to open the academic understanding of some of the challenges and opportunities for climate adaptation planning in much of the state. Additionally with nearly 40% of the U.S. population living within counties adjacent to a shore, this study can be relevant to the portion of those counties that are nonmetro and resource constrained (Kildow et al., 2016). This research can aid in the understanding of the unique adaptation challenges and

opportunities of rural, coastal, and resource-constricted communities as well as add to the base of understanding about adaptation planning at a broad scale.

1.7 Definitions of terms

Adaptation – "Actions taken at the individual, local, regional, and national levels to reduce risks from even today's changed climate conditions and to prepare for impacts from additional changes projected for the future" (Lempert et al., 2018).

Adaptive Capacity – "The ability of human and natural systems to prepare for, adjust to, respond to, and recover from experienced or anticipated climate impacts" (Lempert et al., 2018).

Barrier – "An impediment to specified adaptations for specified actors in their given context that arise from a condition or set of conditions." "A barrier can be valued differently by different actors, and can, in principle, be reduced or overcome" (Eisenack et al., 2014).

Climate change – "Changes in the global weather that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system" (USGCRP, 2018).

Coastal state – "A state of the United States in, or bordering on, the Atlantic, Pacific, or Arctic Ocean, the Gulf of Mexico, Long Island Sound, or one or more of the Great Lakes" (NOAA, 2005).

Enabler – To provide with the means or opportunity. To make possible, practical, or easy (Merriam-Webster, n.d.-a).

Endogenous – Caused by factors inside the system (Merriam-Webster, n.d.-b).

Exogenous – Caused by factors outside the system (Merriam-Webster, n.d.-c).

Rural county – Known as a nonmetro county, a rural county "includes some combination of: open countryside, rural towns (places with fewer than 2,500 people), and urban areas with populations ranging from 2,500 to 49,999 that are not part of larger labor market areas (metropolitan areas)" (USDA ERS, 2018).

Social-ecological systems – Complex, integrated systems in which humans are part of nature (Berkes & Folke, 1998).

Vulnerable populations –Groups that are particularly vulnerable to the health effects of climate change. They include: children, older adults, communities of color, low-income communities, pregnant women, immigrant groups (including those with limited English proficiency), indigenous peoples, the disabled, vulnerable occupational groups, such as workers who are exposed to extreme weather, and people with pre-existing or chronic medical conditions (APHA, n.d.).

Chapter 2. Literature Review

2.1 Adaptation Planning

2.1.1. What is adaptation planning?

One of the main ways for nations, communities, and individuals to address and prepare for the impacts of climate change is through adaptation planning. According to the Fourth National Climate Assessment, "adaptation refers to actions taken at the individual, local, regional, and national levels to reduce risks from even today's changed climate conditions and to prepare for impacts from additional changes projected for the future" (Lempert et al., 2018). This involves both short and long term planning and is largely in conjunction with mitigation, in order to prevent the worst-case-scenario climate change impacts in the future (Lempert et al., 2018).

Among researchers, a deeper, often cited, definition offered by experts Moser & Eckstrom (2010) includes the complex relationship and co-adaptations of socio-ecological systems and recognizes that not all adaptation strategies will result in resilience. "Adaptation involves changes in social-ecological systems in response to actual and expected impacts of climate change in the context of interacting nonclimatic changes. Adaptation strategies and actions can range from short-term coping to longer-term, deeper transformations, aim to meet more than climate change goals alone, and may or may not succeed in moderating harm or exploiting beneficial opportunities" (Moser & Ekstrom, 2010).

The goal of planning has always been around ensuring community decisions are made with the "big-picture" (including future considerations) in mind, while taking into account residents' legal rights and desires for the future of their community. As the basic concept of climate adaptation planning is to consider future climate implications and impacts in current planning decisions, the goals of climate adaptation planning align well will planners' established roles in the community.

2.1.2. How does adaptation planning happen?

Research continually shows there is no single approach to climate adaptation planning, but rather a series of similar approaches and practices found across sectors and regions. In general, the process tends to consist of a series of steps, which can occur in any order, concurrently, or not at all (Bierbaum et al., 2014). Figure 1 shows the framework suggested by the National Climate Assessment (NRC, 2010). Similarly, the framework of the U.S. Climate Resilience Toolkit developed by the National Oceanic and Atmospheric Administration (NOAA) in partnership with other federal departments and agencies list the steps as: 1. Explore Hazards; 2. Assess Vulnerability and Risks; 3. Investigate Options; 4. Prioritize and Plan; and 5. Take Action (NOAA, n.d.). Numerous other climate adaptation resource authorities list similar steps (e.g. CEMA, California Emergency Management Agency; CNRA, 2012; Center for Science in the Earth System (The Climate Impacts Group), 2007).

Figure 1 Basic Adaptation Process Cycle per the 2014 U.S. National Climate Assessment, adapted from the NRC, 2010

Adaptation planning can happen at any level by individuals, businesses, capital investments, etc. (Lempert et al., 2018). Following this or a similar process, communities can create either standalone,

community-wide or small area climate adaptation plans, or integrate climate planning into their regular planning activities and existing area plans. To begin, standalone plans have been found to be the most effective for building local commitment to the plan (Berke et al., 2014), although ultimately the plan should be worked in to existing planning processes and programs (Carmin, 2012). Standalone plans have allowed for academic research to review the type of actions being included in plans, the quality of the plans, the implementation to the plans, and have established a place to start for looking at drivers and barriers of climate adaptation planning.

2.1.3. Who does adaptation planning?

While climate change is happening globally, the impacts of climate change vary by geographic region, socioeconomic, and political location, and are thus felt differently at the local level. Generally, climate change impacts are the most noticeable and affective locally (Baker et al., 2012; Moser & Pike, 2015). With variable policy direction addressing climate change, localities are largely left to deal with the impacts of and plan for the future implications of climate change (Hamin, 2011; NASA, 2018).

The shape climate adaptation planning takes is largely country dependent, with different entities in charge of coming up with strategies and plans. Many countries have enacted National Adaptation Plans while others have left planning to regions, states, or localities to deal with (Mimura et al., 2014). As noted, because the impacts of climate change vary by location, localized climate adaptation planning ensures the specific needs of the community are addressed. While the most relevant adaptation strategies and planning will happen at the local level, national governments can ensure localities have the tools and support they need to effectively address climate concerns (UNFCCC, 2018). Official mandates for local governments requiring climate change adaptation action plans attached to sufficient funding can ensure adaptation action at the local level (UNFCCC, 2018).

Worldwide, several transnational support tools exist to help municipalities adapt to climate change. A well-known example is ICLEI – Local Governments for Sustainability's Cities for Climate Protection (ICLEI) campaign. By joining this international network, cities can connect with other cities and adaptation experts as well as gain access to knowledge-sharing, technical support, up-to-date research and general support in preparing for climate change at the local level. Over 1,500 cities, towns, and regions have joined ICLEI in their pledge for sustainability at the local level (ICLEI, 2018). Other well-known support organizations include the Cities Climate Leadership Group (C-40) and the United Nations' Human Settlements Programme (UN Habitat), among others.

2.2 State of Adaptation Planning

2.2.1. State of Adaptation Planning Worldwide

Internationally, adaptation planning is a formally agreed upon strategy for addressing climate change. Along with committing to keep global temperature increases down, the United Nations Framework Convention on Climate Change (UNFCCC) 2015 Paris Agreement also pledges all signatory countries to adapt to climate change (UNFCC, 2016). The UNFCCC has also established technical guidelines for developing National Adaptation Plans and supports least developed countries (LDC) in developing their plan (UNFCCC, 2018). While this international support exists for approaching adaptation at the international level, a 2012 global survey of ICLEI-member communities showed that 68% of cities worldwide are involved in some level of climate adaptation planning. This ranged from 37% in the preparatory stages to 18% in the realm of implementation (Carmin et al., 2012).

There is currently no existing global inventory of climate adaptation action, but many reports and studies have found extensive examples of adaptation planning happening at various levels globally from National Adaptation Plans to local initiatives and non-governmental adaptation strategies (Mimura et al., 2014). Analysis of existing examples shows that while much is happening, it still is not enough to

fully prepare for the dramatic changes to ways of life ahead (Bierbaum et al., 2013). Adaptation researchers Tompkins, Vincent, Nicholls, and Suckall(2018) have called for including documenting adaptation as a separate step to include in the adaptation planning process to ensure that information-sharing and research can move forward in an informed way.

2.2.2. State of Adaptation Planning in America

In the United States, adaptation policy has been politicized and is thus largely dependent on the administration in power. In 2009, 2013, and 2015, separate executive orders (EOs) (EO 13514, EO 13653, and EO 13593) were signed laying a formal foundation for climate adaptation research and planning, including the development of an Interagency Climate Change Adaptation Task Force and requiring federal agencies to prepare for climate changes. These also required the federal government to guide state, local, and private sector leaders in adaptation preparedness through providing information and advice to state, local, and tribal leaders on how the federal government should respond to climate change (Lysák et al., 2016). These EOs were revoked in 2018 with the change in administration and replaced with policies that focus mainly on energy independence and efficiency. Additionally the National Climate Assessments by the National Global Change Research Group were mandated by Congress starting in 1990 every four years and are meant to advance the scientific knowledge of climate change and its impacts (USGCRP, 2018).

In the United States where planning is predominately done at the local level, local governments may choose to undertake climate change adaptation planning, but no National Adaptation Plan nor national mandate for state or local communities to partake in climate adaptation planning currently exist. Thus, no required framework exists establishing what format and considerations climate adaptation plans must include, resulting in a wide range of actions being included in existing adaptation plans (Stults & Woodruff, 2017). While this inaction at the national level could be considered

problematic, the freedom at the local level to select strategies and planning methodology that are contextually appropriate is effective in the sense that local concerns can be addressed without pushed agendas or narrowed scopes (UNFCC, 2018). Adaptation plans developed by local entities have been found to be more robust than those developed at higher governmental levels (Woodruff & Stults, 2016) as behavioral and reporting standards linked to higher level funding can limit plan potential (Scott, 1995). Since local entities make most important decisions about community actions including land use, infrastructure, hazard mitigation, and water resources, addressing climate change through these existing actions is important for moving adaptation action forward (Berke et al, 2014).

Only extensive research can reveal the state of adaptation planning in the United States because there is no existing central reporting system for adaptation progress (Tompkins et al., 2018; Vogel et al., 2016), a step that has been argued should be included in the adaptation planning process itself (Tompkins et al., 2018). Research at the state level has shown that just about half of states begun climate adaptation planning, though less than half have formally adopted plans (C2ES, n.d.; Lysák & Bugge-Henriksen, 2016). At the city level, of ICLEI-member communities in the United States, 59% have begun climate adaptation planning (Carmin et al., 2012). 2016 research indicates that just over half of US communities working on adaptation are involved in the implementation side of adaptation planning (Nordgren et al., 2016). Most research states that the current efforts for adaptation planning in the US are not sufficient to prevent substantial damage by climate change (Bierbaum et al., 2013; NOAA, 2018).

Of resources available to help local planners in adaptation decision making, a plethora of sources exist. Most of these resources assist communities with the beginning phases of climate adaptation planning such as vulnerability assessments and forming adaptation plans, but fail to meet the needs of communities when it comes to implementation, monitoring, and evaluating (Nordgren et al., 2016).

2.2.3. Climate and health adaptation planning

Planning for the public health impacts of climate change is an added level to adaptation planning. Through the CDC CRSCI, cities and states have begun building adaptive capacity and preparing their health departments and residents for the negative health impacts of climate change (Marinucci et al., 2014). Through this program, public health departments have worked with communities to bring public health into the adaptation conversation (Anderson et al., 2017). Adaptation efforts included in planning such as early warning and response systems, at home cooling systems and cooling shelters, and resilient power grids can all make a difference in protecting the public from the health impacts of climate change (Berisha et al., 2017; Ebi, K.L., J.M. Balbus, G. Luber, A. Bole, A. Crimmins, G. Glass, S. Saha, M.M. Shimamoto, J. Trtanj, 2018; Lane et al., 2014). The CRSCI program has proven effective in building adaptive capacity within local public health agencies through the development of a variety of tools to address the various health concerns of climate change, and has prepared grantees for developing climate and health adaptation plans (Sheehan, Fox, Kaye, & Resnick, 2017). Even so, federal support through CRSCI includes only 16 state and 2 city grantees (CDC, n.d.), and climate and health planning, like land use planning, falls largely to the local level (Sheehan et al., 2017). Overall, far greater efforts are needed to expand the integration of public health into climate adaptation plans across the United States and world (Sheehan et al., 2017).

2.3 Content of Existing Plans

Most studies assessing the actions included in climate adaptation plans find that actions aimed at building adaptive capacity are the most frequently used type of action although a wide range of actions have been found in adaptation plans although recently a shift from capacity building to concrete actions has been found (Stults & Woodruff, 2017). Adaptive capacity refers to “the practice of enhancing the strengths and attributes of, and resources available to, an individual, community, society, or

organization to respond to change" (IPCC, 2018). Depending on the definition the researcher takes of "capacity building", examples include gathering and sharing information; developing human resources; and research and monitoring (Preston et al., 2011; Stults & Woodruff, 2017). Other commonly found actions include land use actions such as green infrastructure, physical infrastructure and building codes; practice and legislation; and planning (Stults & Woodruff, 2017).

Some helpful strategies, such as advocacy and identifying co-benefits, are not commonly found among plans. Considering that some identified barriers to adaptation planning are not addressed in the plans themselves, room for overcoming barriers and improving plans has been identified (Stults & Woodruff, 2017).

2.3.1 Implementation Challenges

A recent evaluation of nationwide climate adaptation plans found plans to be weak in implementation elements, lacking the details previously identified as necessary for plan implementation and effectiveness (Stults & Woodruff, 2017; Woodruff & Stults, 2016). Evaluations of existing climate adaptation plans show that successfully implemented adaptation plans are formed by professionals and approved by community elected officials; involve community participation; involve cross-jurisdictional and cross-sectoral, collaboration; include public and private-sector champions; address multiple community goals; include clear implementation strategies (including timelines, responsible parties, measurable goals, and strategies for plan updates); include details for updating the plan as new information becomes available; include a strategy for monitoring the effectiveness of the plan; and include funding mechanisms for both actions and continued community outreach (Berke et al., 2014; Brody & Highfield, 2005; Highfield & Brody, 2013; Stults & Woodruff, 2017; USGCRP, 2018). Ensuring plans align and advance previously existing community goals, involve stakeholder engagement, and take

advantage of local existing and emerging initiative and opportunities are all vital in helping plans gain traction and support (Carmin et al., 2012).

Additionally, existing resources available for supporting adaptation planners in implementation have been found to be insufficient (Nordgren et al., 2016). The Fourth National Climate Assessment concludes that while adaptation is being implemented in its unique ways throughout the US, implementation remains uncommon (Lempert et al., 2018).

"Mainstreaming" has been found to be an effective way to implement climate adaptation plans (Carmin et al., 2012; Cuevas, 2016). This requires thinking through how actions and climate change considerations can be integrated into other plans and program. In the United States, the most commonly used implementation strategy by communities is mainstreaming (Woodruff & Stults, 2016). Other approaches to facilitate implementation include securing strong leadership; using extreme events, co-benefits, local attitudes, grassroots organizations, and the engagement of vulnerable populations to build community support; developing new forums for dialogue, learning, and collaboration; starting with small projects to facilitate more ambitious programs in the future; using diverse strategies to secure funding; using peer-to-peer networking and learning such as interjurisdictional information sharing groups; and collaborating within and across government (Vogel et al., 2016).

In general, as mainstreaming has been found as an effective way to implement climate change adaptation plan action, mandates requiring localities to integrate adaptation into existing plans can prove effective (Cuevas, 2016; UNFCC, 2018).

2.4. Enablers and Barriers of Climate Change Adaptation

As the negative and dramatic impacts of climate change increasingly dominate news headlines the call for mitigation and adaptation actions also continue to be heard. While some nations, states, and

communities have formally begun to consider climate change adaptation as an action necessary for their community to consider others have not. This action or inaction can stem from a wide variety of reasons (Carmin et al., 2012; Measham et al., 2011).

2.4.1 Enablers of Climate Change Adaptation

Endogenous factors have been found to be some of the key drivers of climate adaptation planning. Endogenous factors include having a local adaptation champion pushing and carrying action; knowledge of projected climate change impacts and a desire to protect local assets; the ability to uphold community values or advance local priorities (around natural resources or ecosystems, or a desire to revitalize the socioeconomic status of a community); climate-network support such as ICLEI, C-40, and UN Habitat; a desire to either act a leader in climate adaptation; and in response to published climate change information (Berrang-Ford et al., 2011; Carmin et al., 2012; Hughes, 2015; A. C. Lesnikowski et al., 2011; Nordgren et al., 2016; Reckien et al., 2015; Vogel et al., 2016). Often an interaction of a combination of factors can lead to what Dilling et al (2017) refer to as an "enabling environment for action."

Exogenous factors have also been found to act as enablers of climate action. Some exogenous factors motivating action are extreme climate events and recently published climate change information (Vogel et al., 2016). While often cited as potentially motivating (Baker et al., 2012), higher-level mandates have been found to be both effective and ineffective drivers of climate adaptation planning (Vogel et al., 2016; Reckien et al., 2015).

2.4.2 Barriers to Climate Adaptation Planning

A large and growing body of research has looked at what the barriers to climate change adaptation planning and implementation are (e.g. Azhoni, Holman, & Jude, 2017; Biesbroek et al., 2013;

Juhola, 2016; Kim, Kim, & Demarie, 2017; Measham et al., 2011; Moser & Ekstrom, 2010; Nordgren, Stults, & Meerow, 2016b; Uittenbroek, 2016). These are generally referred to as barriers to adaptation (Juhola, 2016). While numerous definitions of "barriers" have been offered over time and can shape what is identified by a researcher as a "barrier," a comprehensive definition by Eisenack et al (2014) defines barriers as 'an impediment to specified adaptations for specified actors in their given context that arise from a condition or set of conditions'. In this definition, 'a barrier can be valued differently by different actors, and can, in principle, be reduced or overcome' (Eisenack et al., 2014). The conclusion in this definition that barriers to climate change adaptation and plan implementation are not a general list that can be applied to every situation, but rather contextual and interdependent, with the barriers identified being unique to one specific locality and persons involved (Eisenack et al., 2014). With this concept in mind, the most important aspect to moving beyond barriers is to understand the underlying causes and interdependencies of the barriers themselves (Azhoni et al., 2017; Cuevas, 2016; Eisenack et al., 2014). By understanding and resolving barriers, communities can overcome them and move closer to adaptation action (Moser & Ekstrom, 2010).

Of the existing climate adaptation barriers research, numerous barriers have been identified. While there are themes among the barriers, the list of barriers has been considered "potentially endless" (Biesbroek et al., 2013). For the most part, the barriers to adaptation identified in the literature relate to a lack of resources (including funding and capacity), lack of public awareness, a lack of or difficulty understanding climate information, a lack of leadership, and limited coordination and competing priorities (Biesbroek et al., 2013; Measham et al., 2011; Oulahen et al., 2018; Uittenbroek, 2016). The number one identified barrier is lack of funding (Eisenack et al., 2014; Measham et al., 2011; Moser & Ekstrom, 2010; Nordgren et al., 2016). In comprehensive reviews, the most commonly found *categories* of barriers are broadly related to institutional (role of governments (bottom-up vs. top-down)) and social (values of actors) dimensions of adaptation (Biesbroek et al., 2013). Other, similar,

categorizations include institutional, attitudinal, financial, and political categories of barriers (Ekstrom & Moser, 2014). The majority of barriers appear during plan implementation (Biesbroek et al., 2013). This wide variety of barriers and categories reiterates the importance of understanding the contextual and interdependent nature of adaptation barriers (Eisenack et al., 2014; Hamin, Gurran, & Emlinger, 2014; Lehmann et al., 2015).

Many factors, such as a hierarchal governing system (Phuong et al., 2018), have been found to act as both barriers and/or enablers depending on context and actors. As in many policy fields, understanding the breadth (including context) of forces influencing the success of the policy at hand is important for ensuring successful implementation.

2.4.3 North American Research Contexts

While there have been some comprehensive studies comparing barriers nationally or globally identified in the research (Rosina Bierbaum et al., 2013b; Biesbroek et al., 2013) most of the research has been location-specific assessing the barriers of specific contexts (e.g. (Azhoni et al., 2017; Carmin et al., 2012; Measham et al., 2011; Raymond & Robinson, 2013). Of these contexts, most of the research on barriers has been conducted in developing countries. Of research in North America and the United States, research on barriers and enablers has taken place in New England (E. M. Hamin et al., 2014; Lonsdale et al., 2017), the Rocky Mountains (Lonsdale et al., 2017), the Intermountain West (Dilling, Pizzi, Berggren, Ravikumar, & Andersson, 2017), the Great Plains (Wood et al., 2014), the ocean coast (Casey & Becker, 2019), and in urban areas of Michigan (Nordgren et al., 2016). No research has looked specifically at rural, coastal communities in the Great Lakes Region.

Of the research conducted on barriers and enablers in the United States, the geographies studied that closest resemble rural, coastal Michigan, are the Great Plains and urban areas in Michigan. Exploring climate change policies in the Great Plains, a conversely heavily agricultural-based area (USDA

ERS, 2015), Wood et al (2014) found that adaptation policies are more often implemented than mitigation policies, although both have very low implementation rates (Wood et al., 2014). Looking at the motivations for adopting mitigation and adaptation policies, they found that mayoral agreement to act if the federal government did not, and percent of Democratic vote were found to be correlated with the adoption of policies. Looking at barriers to adaptation in urban areas of Michigan, Nordgren et al (2016) found the main impediments to adaptation to be a lack of funding and staff time and inaccessible resource formats, such as scientific reports, trainings, or workshops rather than guidance on identifying financial support or adaptation policy guides**.**

2.4.4 Rural Adaptation Planning

While understudied in terms of taking action to respond, rural areas have been identified as particularly vulnerable to the negative impacts of climate change due to their relatively weaker capacity to respond than urban areas and high rates of vulnerable populations (Lal et al., 2011; USGCRP, 2018). Disadvantages faced by rural areas include limited code enforcement (Rosser, 2006), high poverty rates, economic/social resource-dependence, an aging population, physical isolation, lower income levels, lack of jobs, limited access to the internet, minimum political sway, and limited community resources (Lal et al., 2011; USGCRP, 2018). With high rates of vulnerable populations, rural communities are also subject to what researchers Morello et al (2009) identified as the “climate gap”. Through the climate gap, inequality is disproportionately exacerbated through climate change for populations that are already considered vulnerable under normal circumstances.

Chapter 3. Methods

3.1 Study design

In order to answer the two basic research questions and understand the barriers and enablers to climate and health adaptation planning in rural, coastal Michigan counties, a qualitative, mixed-methods approach was adopted. A study approach was selected based off similar research on the topic (Azhoni et al., 2017; E. M. Hamin et al., 2014). The study used a mixed methods design conducted over two periods: 1) a survey to a broader audience followed by 2) interviews to select participants. This design aimed to gather largely qualitative data from public officials representative of a variety of offices throughout Marquette County around the enablers and barriers to climate and health adaptation planning and implementation. The results were then examined within the greater literature on climate adaptation planning to draw conclusions.

This method was based off similar research by others which largely been conducted through interviews and surveys. Most use studies of select areas to understand the barriers and enablers within a specific context (e.g. (Azhoni et al., 2017; Carmin et al., 2012; Measham et al., 2011), while some have broaden the context to the national or global scale (Biesbroek et al., 2013; Nordgren et al., 2016).

3.2 Study background

The study was conducted as part of the larger Marquette County Climate and Health Adaptation Project. This project, made possible by funding from the CDC CRSCI, aimed to pilot interventions to prevent or reduce negative human health impacts from climate change in a rural, coastal community (MSU, 2018).

Beginning in 2017, the Michigan State University (MSU) School of Planning Design and Construction (SPDC) Sustainable Built Environment Initiative (SBEI) began working in partnership with

the Michigan Department of Health and Human Services Michigan Climate and Health Program, to develop and implement a Climate and Health Adaptation Plan for a rural, coastal county in Michigan. Marquette County, designated a rural county by the USDA and coastal according to NOAA, was selected as the community for the Marquette Area Climate and Health Project.

Between 2017 and 2018, the team met with community stakeholders and held public meetings to gather community input on climate and health concerns and proposed strategies. These resulted in the publication of two Volumes of the Marquette County Climate and Health Adaptation Guidebook addressing the primary climate and health concerns identified by the community through the process: vector awareness, air quality, emergency response and extreme events, and water related concerns. Volume I, Stakeholder Engagement and Visual Design Imaging, explained the planning process and used visual design renderings of locations in Marquette County to convey the benefits of climate and health adaptation strategies. Volume II, Policy Recommendations for Enacting Adaptive Built Environment Changes, included a menu of climate and health adaptation policy recommendations that would address the concerns identified in Marquette County. The policy recommendations also included metrics the community could use to measure the impact of implementing those strategies. The strategies and metrics were developed throughout the iterative process, and ultimately approved by the plan steering committee, the Marquette County Climate Adaptation Task Force (CATF).

In 2019, the project focused on developing an implementation strategy to ensure the operationalization of the plan. The implementation process began with an initial workshop, the Implementation Prioritization Workshop, early in 2019 with 50 public officials working in Marquette County who would have roles in implementing the plan. At the meeting, participants using dot voting to decide the priority climate and health policies for implementation. Voting was followed by group work to provide the details necessary for implementing the priority policies. Four workgroups were formed around the community's priority climate and health concerns: vector awareness, air quality, emergency

response and extreme events, and water related concerns. This meeting was the forum for the surveys in this study.

The project has continued post-data gathering for this study. A second implementation workshop later in 2019 was used to provide further details for the implementation of the top strategies identified at the Implementation Prioritization Workshop. In 2020, the project focuses on the implementation of strategies within select communities in the county.

Throughout the project, visualizations were used to educate the community on climate and health adaptation related to the primary concerns of the county. Before and after design renderings were used to show locations vulnerable to the negative health impacts of climate change and how adaptation strategies could look in those locations. Icons and explanations as to how these adaptations relate to health were included. Visualizations were used at the public workshops and within the guidebook volumes to educate the public and community leaders.

3.2.1 Study area selection

Marquette County, designated a rural county by the USDA and coastal by NOAA, was selected for the MDHHS/MSU Marquette Area Climate and Health Project and this study for several reasons. First was their identified health vulnerabilities to climate change through a statewide assessment (Cameron, Ferguson, Walker, Briley, & Brown, 2015) Secondly was its designation as a rural, coastal county in Michigan (NOAA, 2005; USDA ERS, 2018). Finally was their relatively advanced state of adaptation planning and awareness around the issues of climate change. Through this study, it represents a rural, coastal county in an advanced state of adaptation planning.

Previous research in the area on climate change planning has identified the community as on the “alarmist” end of the Yale Six Americas spectrum (Crawford et al., 2018). The Yale Six Americas spectrum ranks communities in terms of where the public in the community lie in terms of their

perspectives climate change beliefs, risk perceptions, and policy support (YPCCC, 2019). In response, the community, through a range of players, has undertaken the numerous adaptation initiatives, making them one of the 39 communities in Michigan acting on climate change through planning (Beckett&Raeder & LIAA, 2017). For example, the city, county and region already have adopted climate action and adaptation plans, while some municipalities as well have begun to make plans. Highly active regional groups such as the Superior Watershed Partnership and Land Conservancy, a nonprofit dedicated to implementing environmentally-centered projects, have been effective in keeping the conversation around climate change and action going at the local level (MSU SPDC, 2018). The county has designated a countywide, collaborative Climate Adaptation Task Force (CATF) who meets regularly to work across sectors and jurisdictions to address climate change.

With this level of activity, the community represents a rural, coastal county actively addressing climate change and relatively advanced in adaptation planning. While not representative of all communities, this unique context can reveal barriers and enablers for rural, coastal communities already taking action rather than for those just getting started. Identifying and exploring the barriers and enablers in the context of a county and community supportive of action, may also suggest why the implementation of climate adaption initiatives is so low (Stults & Woodruff, 2017; Wood et al., 2014; Woodruff & Stults, 2016), and identify some of the likely obstacles or opportunities for communities just getting started.

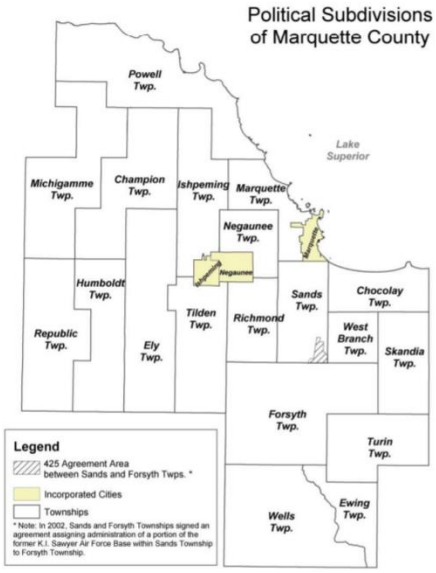
3.3 Study area description

Marquette County is a rural, coastal county located in the Upper Peninsula of the U.S. State of Michigan on the banks of Lake Superior. The county is 1,873 square miles of land (3,425 square miles total area) and is the largest in Michigan (Marquette, 2015). Fairly remote, the county is approximately

390 miles from the state capital. As shown in Figure 2, the county holds 22 local units of government – 19 townships and three cities. The 2010 U.S. Census reported population was 67,077.

Figure 2 Political Subdivisions, Marquette County

Source: Hazard Mitigation Plan: Marquette County, MI, 2015



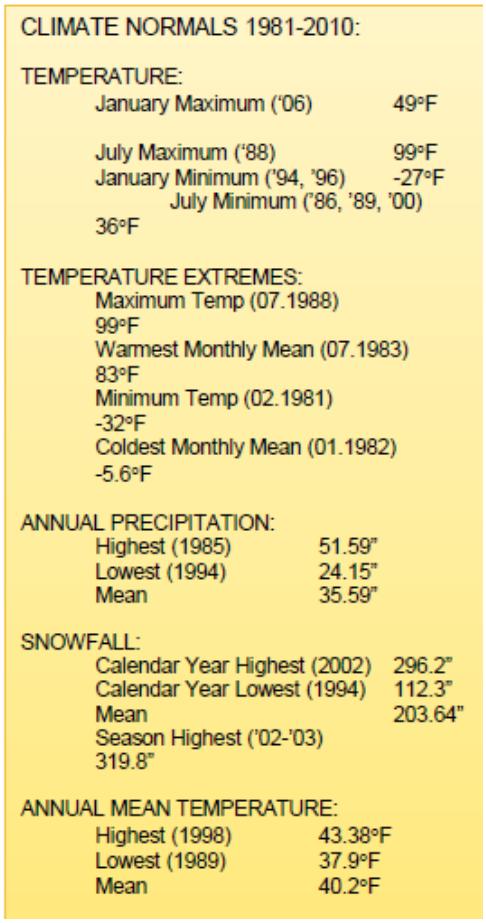
The County has eighty miles of shoreline, lakes, wetlands, ponds, cliffs, sandy beaches, and forested areas. Residents pride themselves on the natural beauty of their surrounding and the vastness of the wilderness around them.

As many of the existing communities in the County were built around now-closed iron ore mines, residents face long drive times to get to work and often to get to basic amenities. For example, in the unincorporated community of K.I. Sawyer (population 3,209) (lying within the jurisdictions of Forsyth, Sands, and West Branch townships), 90% residents drive to work, with over 80% of those driving between 10 and 90 or more minutes to work. The average K.I. Sawyer resident-worker drives between 20 and 40 minutes to work. The nearest gas station or grocery store for this community is 7 miles away in the community of Gwinn.

Traditionally, Marquette County has early, long, cold, and snowy winters, cool springs, warm summers, and warmer to cooling falls. Lake Superior historically builds significant ice cover throughout the winter and on occasion has fully frozen over. Figure 3 Marquette County Climate Normals 1981-2010 shows the average climate for Marquette County (GLISA, 2014).

Figure 3 Marquette County Climate Normals 1981-2010

***Source**: Hazard Mitigation Plan: Marquette*



3.3.1 Climate Projections

With climate change, Marquette County is experiencing higher overall temperatures, with the most significant average temperature increase happening in the winter (GLISA, 2014). Table 1 shows the change in the average temperature by season for the area over the past 65 years. Additionally, the area has experienced decreased overall precipitation, with notable precipitation increases in the fall and winter with decreases in the spring and summer. Table 2 shows the change in the average precipitation by season for the area over the past 65 years. More frequent and intense extreme weather events have also been recently experienced, such as increased periods of intense rainfall and periods of drought.

Table 1 Change in Temperature from 1951 to 2017 (°F) in Western Upper Michigan GLISA, http://glisa.umich.edu/division/mi01

Annual	**+2.7**
Winter	+3.9
Spring	+2.5
Summer	+2.1
Fall	+2.5

Table 2 Change in Precipitation from 1951 to 2017 in Western Upper Michigan
Source: GLISA, http://glisa.umich.edu/division/mi01

	in.	%
Annual	-0.4	-1.21
Winter	+0.5	10.11
Spring	-0.4	-4.95
Summer	-1.7	-15.70
Fall	+1.3	14.95

The area also faces warming lake temperatures leading to decreased ice cover on Lake Superior and earlier lake stratification. Falling lake levels have resulted from reduced precipitation and increased evaporation. Warmer lake and air temperatures and reduced ice coverage have resulted in historic public health concerns such as beach closures due to high bacterial counts (King & Tiller, 2013).

Local leaders have reported floods impacting roads and water treatment facilities; wildfires reducing road access and cutting off power; extreme cold snaps freezing and bursting pipes; stormwater runoff and higher temperatures leading to beach contamination; and dry periods causing aquifer depletion and water shortages. Focus group meetings in the community revealed the priority climate

and health concerns for the area to be increased vector borne diseases, impacts from wildfires, worsening air quality, and flooding and drought events.

The trends in the changes already experienced are expected to continue or accelerate into the future (GLISA, 2014). Climate projection models expect that average temperatures for the region will rise by 3.5 to 6 degrees Fahrenheit by mid-century. With the rise for the region, temperatures for the northern Great Lakes subregion are expected to warm even more quickly. With this warming, the freeze-free season for the area is expected to increase by 1-2 months (for the high emissions scenario). As already experienced, overall precipitation is expected to increase, although summer precipitation may decline. Snow fall, which helps supply water in the summer and insulates in the winter, is expected to decrease (GLISA, 2014).

3.4 Data collection and analysis

The study population for both the survey and interviews consisted of public officials working in Marquette County. Approval for the study from the MSU Institutional Review Board (IRB) was obtained before the survey and interviews were conducted and survey participants were informed that their responses would anonymous apart from taking part in the workshop. Interviewees agreed through participating to have their answers recorded for masters-level research.

3.4.1 Survey

The first data collection consisted of a survey distributed at the January 2019 Climate and Health Adaptation Implementation Prioritization Workshop mentioned previously. This workshop involved fifty public officials from around Marquette County, representing local units of government, the county, and the region, and at least 28 organizations. The attendees were invited based on their previous participation in the project since 2017 as well as their role related to climate and health policy

implementation in the County. The original invite for the workshop went to 80+ participants through email, and participants were then called to encourage they attend. CATF, consisting of members known throughout the community sent the invitations and made the follow up calls. Of those attending the meeting, 31 participants completed the survey.

While the complete survey consisted of 21 questions mostly evaluating the overall project effectiveness and suggested improvements, only two questions related to this study were included. The two questions were open ended and directly asked about the top three barriers and enablers to climate and health adaptation implementation:

1. What are the top three barriers your community or organization faces in the implementation of the climate and health adaptation strategies presented today? (e.g. lack of funding; lack of leadership; insufficient staffing)
2. What are the top three enablers your community or organization has in the implementation of these climate and health adaptation strategies presented today? (e.g. interested leaders; existing outside assistance; strong community interest)

The survey questions were peer reviewed by a panel of experts prior to the workshop and refined for clarity and brevity.

General questions on the survey included jurisdiction of work, profession, and community of residents. Professions were categorized into 5 categories: local government; education/academics; health professional; consulting engineer/designer; and other. Of those responding to the survey, the largest percentage worked for local government (42%) or other (32%). Of those that selected “other” and specified their profession, most were professions related to local government, but specified responses included private enterprises, utility workers, non-profit workers, emergency response workers, community and regional planners, Road Commission members, jurisdiction Board members, and others. Table 3 shows the distribution of respondents according to their profession.

Table 3. Frequency of professions of survey respondents

Profession	Frequency	Percent
Local government	13	41.9
Other	10	32.3
Education/Academics	4	12.9
Health Professional	3	9.7
Consulting Engineer/Designer	1	3.2
Total	31	100.0

3.4.2 Interviews

Following the analysis of the surveys, a second data collection period of follow up interviews was conducted to clarify and deepen the understanding of some of the nuances of the survey responses. Interview participants were selected based on their previous participation in the project and their jurisdictional representation. The selection aimed to include individuals active in climate and health adaptation and representative of a range of jurisdictions throughout the county. Representatives from the State, Regional, County, and local level were selected. The selection was made by the researcher with input from planners involved in the project from the beginning. Nine participants were originally contacted through email for the interviews. Reminder emails were sent three weeks later to request participation from those who had not responded. Ultimately, six responded and were interviewed in July of 2019. The interviews represented the state, region, county, and city. Table 4 shows the service area, and the service community of each interviewee.

Table 4. The service area and the people served of each interviewee.

Service Area	Service Community
State	Community level nonprofits and municipal governments. Other departments/programs within MDHHS. CDC mandate is to investigate interventions for all residents
Region - Entire UP, primarily Upper Great Lakes	Municipal units of governments, organizations, and nonprofits within region.
Region - Alger, Delta, Dickinson, Marquette, Menominee, and Schoolcraft Counties, Cities, Townships, and Villages.	Municipal units of governments, organizations, and nonprofits in that region.
Region - Principal coverage over entire UP. Marquette County.	Communities - Municipal governments, nonprofits, organizations.
Marquette County	Residents of Marquette County
Local	City of Marquette residents

The interviews consisted of 30-minute individual phone interviews asking 6 questions related to the barriers and enablers of climate and health adaptation planning faced by the participants in their work. Answers were recorded through notetaking by the interviewer during the interview, and thus the results reflect the main idea of the response rather than exact quotes. The questions included:

1. How does your organization address climate and health adaptation in your everyday work and long-term projects?
2. What do you see as the barriers you and your organization face in planning for and implementing climate and health adaptation for the people you serve?
3. What barriers do you think are unique to climate and health planning and implementation in a rural context?
4. What do you see as the enablers you and your organization face in planning for and implementing climate and health adaptation for the people you serve? Enablers in this context refer to people or systems within your organization that aid in or create opportunity for policies or actions related to climate and health adaptation.
5. What enablers do you think are unique to climate and health planning and implementation in a rural context?

6. Do you have any more insight or ideas to share about what can help climate and health planning and implementation happen in your organization and county?

3.5 Data analysis

A grounded theory approach was used to analyze the responses of the surveys and interviews. This approach systematically codes the data into concepts and then groups the concepts into categories to identify emerging themes (Berelson, 1971; Leedy & Ormrod, 2016).

Conducted first, the survey responses were categorized into common themes. Barriers and enablers were separately categorized based on the responses given. Once categorized, the responses were analyzed by looking at frequency of responses and comparing that to the greater literature on barriers and enablers.

After the interviews, responses were first categorized according to the categories previously established from the survey results. New categories were created when the results didn't appropriately fit an existing category. After categorizing the responses, trends were identified through frequency. Next, the responses were reviewed using a keyword-in-context analysis in order to consider the responses within their larger contextual dialogue (Leech & Onwuegbuzie, 2007; Onwuegbuzie, Leech, & Collins, 2012).

Together, Interview data was used to add richness the findings of the survey and to reveal findings not unveiled through survey alone. The results of the survey and interviews were used to draw conclusions about the barriers and enablers surrounding climate and health adaptation planning in Marquette County.

Chapter 4. Findings

4.1 Survey findings

There were 31 participants (*n=31)* that completed the survey. Three survey participants skipped the question related to barriers, and nine skipped the question related to enablers. These were excluded from the analysis of the respective topic. While asked to provide three enablers and three barriers, some participants chose to provide only one or two of each. These answers were still included in the results. Two participants responded that there are in fact no enablers. Because they actively chose to make this comment, this response was included in the list of responses. In total, 8 barriers and 10 enablers emerged as themes.

4.1.1 Barriers

In total, 29 participants (*n=29)* provided 59 responses for barriers to climate and health adaptation. Responses fell generally into eight categories of barriers: *insufficient funding; insufficient staffing/time; lack of expertise/technical support; lack of organizational awareness; lack of leadership/ownership; lack of community interest/support; lack of community education;* and *lack of good communication/collaboration*.

The three most common barriers were insufficient funding, insufficient staff/time, and lack of community support/interest. Insufficient funding, was overwhelmingly recognized as the top barrier, cited by 23 of the 29 participants as one of the top three barriers to climate adaptation planning. The next most common was insufficient staffing/time with almost half of participants (14/29) mentioning it as a barrier, while lack of community interest/support was the third most frequently cites (7/29). The other five, lack of leadership/ownership (4/29), lack of community education (3/29), lack of expertise/technical support (2/29), lack of good communication/collaboration (2/29), and lack of organizational awareness (1/29), were less commonly mentioned. Table 5 and

Figure 4 Word cloud of responses of barrier-related survey question

Figure 4 show the results of survey question related to barriers.

Table 5. Survey responses to "What are the top three barriers your community or organization faces in the implementation of the climate and health adaptation strategies presented today? (e.g. lack of funding; lack of leadership; insufficient staffing)"

Barriers to adaptation	Frequency
Insufficient funding	23
Insufficient staffing/time	14
Lack of community support/interest	7
Lack of leadership/ownership	4
Lack of community education	3
Lack of expertise/technical support	2
Lack of good communication/collaboration	2
Lack of organizational awareness	1
Total responses	59

Figure 4 Word cloud of responses of barrier-related survey question. Word clouds depict the frequency words were mentioned, with larger words showing a higher frequency.

4.1.2 Enablers

In total, 22 participants *(n=22)* offered 29 answers for enablers to climate adaptation planning. Responses fell into 10 themes: interested/involved leaders; community interest; outside assistance;

knowledgeable/aware staff; networks/collaboration; greenspace/rurality; local climate events; strong organizations; regulatory ability; and no enablers.

The top three enablers mentioned were interested/involved leaders (8/22), community interest (7/22), and outside assistance (4/22). These were followed by knowledgeable/aware staff (3/22), networks/collaboration (1/22), greenspace/rurality (1/22), local climate events (1/22), strong organizations (1/22), and regulatory ability (1/22). Two respondents said outright that there are no enablers. Table 6 and Figure 5 show the frequency of the results of the survey question related to enablers.

Table 6. Survey responses to "What are the top three enablers your community or organization has in the implementation of these climate and health adaptation strategies presented today? (e.g. interested leaders; existing outside assistance; strong community interest)"

Enablers to adaptation	Frequency
Interested/involved leaders	8
Community interest	7
Outside assistance	4
Knowledgeable/aware staff	3
There are no enablers	2
Greenspace/rurality	1
Local climate events	1
Networks/collaboration	1
Regulatory ability	1
Strong organizations	1
Total	29

Figure 5 Word cloud of responses of enabler-related survey question. Word clouds depict the frequency words were mentioned, with larger words showing a higher frequency.

4.2 Interview findings

In this section, the interview results are presented. Interview results were categorized first according to how they supported the survey, and then by new categories revealed during the meeting.

4.2.1 How Interviewee's address climate and health

To understand how different organizations directly or indirectly address climate and health adaptation planning, interview participants were asked "How does your organization address climate and health adaptation in your everyday work and long-term projects?". Table 7 shows how different organizations working within Marquette County are addressing climate and health adaptation. Most of the organizations reported work directly addressing climate and health adaptation, although much work was as a result of indirect action, especially at the city level through general best practices, such as installing bike lanes and energy updates.

Table 7. How interviewee organizations are addressing climate and health adaptation.

Service Area	How does your organization address climate and health adaptation in your everyday work and long-term projects?
State	1. Mandate from federal government to investigate interventions 2. Program strategic plan relates to adaptation. 3. Works to build awareness in other State programs (ex. Environmental tracking, asthma program, infectious disease, emergency preparedness) 4. Focus of mitigation vs. adaptation depends on State administration and whether they follow Michigan's Climate Actions Plan.
Region	1. Create multiple climate action/adaptation plans (CAP) and specific watershed management plans 2. Assist City of Marquette and Marquette County in climate action 3. Through various networks - CATF, Partners for Watershed Restoration (over 200 members from central UP to western UP (ex. tribes, US Forest Service)) to implement Lake Superior Lakewide Action and Management Plan (climate is focus area) 4. Networking, plans, education, on the ground work (data collection, GI, field staff working with community, inventory dams) (ex. Relocating 1 mile stretch of Lakeshore Boulevard and restoring the coastal habitat; GI projects such as replacing culverts)
Region	1. Assists in Master Plans, Hazard Mitigation Plans, Asset Management Plans, Capital Improvement Plans, and now-mandated Regional Resiliency Plans 2. Administers mini grants (some include rain garden) through Regional Prosperity Initiative 3. Other grant writing, letters of support for climate adaptation, and some mapping
Region	1. Historically indirectly addressed by land use team through general good planning principles (e.g. placemaking, smart growth, protected landscapes). Never explicitly for adaptation purpose. 2. Part of organization's Climate Outreach team – Includes broad networking across areas of expertise. Since organized 10 years ago, the organization has directly addressed the topic. Team learns together and works to network about opportunities to program in the area.
Marquette County	1. Indirectly through health department employee emergency preparedness training. For flood or wildfire event some health department staff would be engaged in disaster response. 2. Grants – MICHAP grant has built internal knowledge and capacity to address climate and health directly. Following this capacity building, another recent grant allowed for the local development of a public health response to flooding events in rural areas (addressing issues such as access and failed septic systems). Another was used to develop the public health component of an emergency sheltering center such as food safety and medical care.
Local	1. Not really an everyday priority, except what has been adopted into codes from 2013 Climate Adaptation Plan. 2013 City of Marquette Adaptation Plan is action specifically taken to address climate change. Priority was water quality and reduce pollution. 2. Engaging in actions of no regret. E.g. Energy conservation, renewable energy, runoff reduction, bike lanes, etc. are actions the City would take, for financial or other reasons, regardless of climate connection. 3. Participant of CATF and Great Lakes One Water initiative 5. In response to high water levels - moving Lakeshore Boulevard inland due to storm damage from atypical November-like storms in summer.

4.2.2 Barriers

Interviewees were asked two questions about barriers, one specific to their organization and one on their perception of barriers specific to rural areas:

1. What do you see as the barriers you and your organization face in planning for and implementing climate and health adaptation for the people you serve?
2. What barriers do you think are unique to climate and health planning and implementation in a rural context?

Funding and staffing capacity/time were the most frequently mentioned barriers experienced by organizations. In general, the related lack of awareness at the organization, competing priorities, and political barriers were the next most commonly mentioned. For rural areas in particular, barriers included insufficient staffing, lack of expertise/technical support, and the challenge ofcommunity education/communication. Table 8 shows the keyword topics of the barriers within their organizations identified by the participants. Figure 6 shows a word cloud of the barriers experienced by the organizations of the interviewees for climate and health adaptation planning.

Table 8. Keyword topics of barriers within their organizations identified by the participants

Keyword topics (organizational)	Frequency
Insufficient funding	6
Insufficient staffing/time	4
Lack of organizational awareness/priority/politics	3
Lack of community education/communication	1
Lack of community support/interest	1
Lack of good organizational communication/collaboration	1
Lack of leadership/ownership	1
Lack of expertise/technical support	0

When asked about barriers specific to rural areas, participants noted communication, staffing, and expertise. Table 9 shows the keyword topics of the barriers identified by the participants as unique to rural areas. Figure 7 shows a word cloud of the climate and health planning barriers perceived by the interviewees to be unique to rural areas.

Table 9. Keyword topics of barriers identified by participants as unique to rural areas

Keyword topics (rural)	Frequency
Insufficient staffing/time	5
Lack of expertise/technical support	4
Lack of community education/communication/large geography	3
Insufficient funding	1
Lack of good organizational communication/collaboration	1
Lack of leadership/ownership	1
Lack of organizational awareness/priority/politics	1
Lack of community support/interest	0

Figure 6 A word cloud of the organizational barriers to climate and health adaptation planning mentioned by the interview participants. Word clouds depict the frequency words were mentioned, with larger words showing a higher frequency.

Figure 7 A word cloud of rural-specific barriers to climate and health adaptation planning mentioned by the interview participants. Word clouds depict the frequency words were mentioned, with larger words showing a higher frequency.

4.2.3 Enablers

Similarly, interviewees were asked two questions about enablers to climate and health adaptation planning and implementation, relating to their organization specifically and their perception of enablers specific to rural areas:

1. What do you see as the enablers you and your organization face in planning for and implementing climate and health adaptation for the people you serve? Enablers in this context refer to people or systems within your organization that aid in or create opportunity for policies or actions related to climate and health adaptation.
2. What enablers do you think are unique to climate and health planning and implementation in a rural context?

The most commonly cited enablers in the interviews for organizations were strong networks and collaboration, interested/involved leaders, and community interest. Specific to rural areas they were strong networks and collaboration, a strong connection between humans and land, access to trusted

local experts and fewer people to collaborate between. Table 10 shows the keyword topics of the enablers within their organizations identified by the participants while Table 11 shows the keyword topics of the enablers identified by the participants as unique to rural areas. Figure 8 shows a word clouds of the most commonly mentioned organizational enablers while Figure 9 shows a word cloud of the most frequently mentioned enablers for rural areas.

Table 10. Keyword topics of enablers within their organizations identified by the participants

Keyword topics (organizational)	Frequency
Interested/involved leaders	4
Networks/collaboration	4
Community interest	2
Staffing capacity	2
New beyond survey: Access to/trust of local experts	1
New beyond survey: Publicity and relatability	1
Outside assistance	1

Table 11. Keyword topics of enablers identified by participants as unique to rural areas

Keyword topics (rural)	Frequency
Networks/collaboration	5
Greenspace/rural identity	3
New beyond survey: Access to/trust of local experts	2
New beyond survey: Fewer to collaborate	2
Community interest	1

Figure 8 A word cloud of organizational enablers to climate and health adaptation planning mentioned by the interview participants. Word clouds depict the frequency words were mentioned, with larger words showing a higher frequency

Figure 9 A word cloud of rural-specific enablers to climate and health adaptation planning mentioned by the interview participants. Word clouds depict the frequency words were mentioned, with larger words showing a higher frequency.

4.3 Survey and interview combined results

Survey and interview responses are organized into two sections: first, how the interview results support the survey findings, and second, new information the interviews revealed. Interview results mainly supported the survey, as well as revealed new information related to barriers and enablers to climate and health adaptation planning.

4.3.1 Barriers

The barriers mentioned by the interviewees echoed closely those of the survey participants. Like the survey, funding and staffing capacity/time were the most frequently mentioned barriers experienced by organizations.

Insufficient funding

Very similar to the survey findings in which 23 of the 29 respondents mentioned funding barriers, every single interview participant mentioned funding as a barrier to climate and health adaptation planning within their organization. Usually, it was the first response provided for the question, and was said in a tone indicating it was an obvious answer. Within funding, several unique reasons were revealed as problematic.

At the state, it was noted that unless their state or local level partners are funded specifically to work on climate and health adaptation, motivating action can be difficult.

At the regional level, funding was mentioned as the number one barrier, as well as issues with budget timelines. When funding might be available, the varying budget timelines of different partners can cause slowdowns. Additionally at the county level, a lack of incentives, reduced budgets, and funding only for mandated action were aspects of the funding barrier preventing climate adaptation

planning from being a priority. Similarly at the local level, funding beyond covering basic services was reported as out of the question without raising taxes.

Overall, funding for a variety of reasons including budget cuts, varying budget timelines, a lack of financial incentives, and an avoidance of raising taxes are problematic for climate adaptation planning.

Insufficient funding as a rural barrier

While mentioned as a general barrier, participants recognized this as a barrier across settings, urban or rural. However, one interviewee pointed out that in selecting communities for grant funding related to adaptation, rural areas are often overlooked. Funding from service providers tend to go to urban areas, while rural, smaller communities with fewer resources are passed up.

Insufficient staffing/time

Somewhat related to funding but specified as a barrier was a lack of capacity and staffing. Half of interview participants identified this directly as an issue in their organization, and others alluded to it through other barriers, such as funding. This finding echoes the survey results in which nearly half of participants (13/29) listed this as a barrier.

As reported by the interviewees, at the regional level and county levels, a lack of staff prohibits intensive adaptation-focused work with individual organizations/units of government. For local units of government lacking planning staff, regional and county organizations lack the capacity to dedicate staff for long-term, hands-on, time consuming projects.

Insufficient staffing/time as a rural barrier

Nearly all the participants named insufficient staffing/time as a barrier unique to the rural nature of their community. While staffing and capacity can be an issue in organizations regardless of

settings, the issue was reported to be exacerbated in the rural context, as municipal planning services are generally limited. Relatively few of the 22 local units of government in Marquette County have planning staff. Most municipalities in Marquette County have no existing planning staff. Of those that do, they may have only one dedicated planner, or possibly only a part-time zoning administrator whose time is spent on more day-to-day tasks. In most cases, a city/township/village manager or other public official fill the role of planners along with their other duties. In general, planning is largely left to county or regional entities or consultants to tackle. With more pressing, immediate concerns, climate and health adaptation planning can be abstract and unmanageable.

Lack of community support/interest

A lack of community support/interest was listed as a barrier at the local level. It was noted that when climate change doesn't appear to be having an acute impact, residents don't tend to be especially concerned.

Lack of community support/interest as a rural barrier

Although only noted as experienced by the local level interviewee, at the regional level, a lack of community support/interest was listed as an issue unique to rural areas. The interviewee noted that local communities lack champions to sustain adaptation efforts within the community.

Lack of leadership/ownership

At the local level, a lack of ownership for taking action to adapt to or to mitigate climate change was cited as a barrier to action. A lack of ownership was expressed in two ways: first, as having minimal impact in the face of a global crisis, and second, as mitigation/adaptation not being a duty of local government. Related to the former, a sentiment was voiced that mitigation/adaptation actions by a small, rural community would have very little impact in the greater context of climate change. Related

to the second, and also related to funding and politics, it was expressed that since local governments often can barely cover basic services, mitigation/adaptation planning is out of their scope of duty.

Lack of community education (across a large geographical area)

Through the interviews, it became obvious that a lack of community education/communication was related directly to the large geographical area of the rural county. At the state, regional, and county levels, communication with rural residents was expressed as a challenge. One interviewee expressed this as a barrier for their organization directly, while three voiced this an as issue specific to rural areas.

A lack of broadband internet throughout the rural county as well as a large proportion of elderly residents were both notes as playing a role in the limited communication. Additionally, the sheer geographical size of Marquette County and the remote "out in the sticks" (i.e. isolated locations) lifestyles of some residents makes engagement challenging.

Amplifying the difficultly of engaging and educating residents of the Upper Peninsula is the local spirit of independence. There is a sense among residents that UP communities can take care of themselves and don't need outside assistance. With this mentality, outside help/expertise is seen by some as an infringement on their territory and not openly valued.

Lack of expertise/technical support

While none of the participants noted a lack of expertise/technical support as a barrier within their organization, four of the six interviewees noted this as a barrier for rural communities in general. This was noted as a rural barrier at the state, regional, and county levels.

At the state level, there was an acknowledgement that the academic and practical literature lacks an understanding of how climate change impacts rural communities and how rural communities should respond. Similarly noted at the regional level was the communication gap between the academic literature and community leaders on solutions, research, and general climate change impacts. Further

local officials lack data or access to the data necessary to take action. This gap in data refers to missing infrastructure records, as well as a lack of access to historic climate data (both its existence and an understanding on how to obtain that data at the local level).

Exacerbating the lack of information as well as the lack of community education, participants noted the "brain drain" phenomenon. This refers to the fact that residents with an education tend to move away and residents that stay tend to have a "mentality of generations back, who don't see climate change as an issue."

Lack of good communication/collaboration (at the governmental level)

A lack of collaboration and communication was also noted between government and organizational entities. At the state level this was remarked as a general disconnect between public health officials and local officials and planners. Even before talking about climate change, the general conversation in rural or urban areas around public health as it relates to official decision making isn't always present. Introducing the relatively uncertain element of climate change beyond simply environmental health, can be a challenge.

Specific to rural areas, a lack of an existing structure for a "holistic approach" to address "climate and health issues across multiple boundaries" was noted at the regional level. Programming that overlaps across multiple issues could be bolstered and possibly be made more effective if a structure for collaborative overlap were to exist.

Lack of organizational awareness/not a priority/political barriers

In the interviews, a lack of awareness related to political barriers resulting in a failure to prioritize climate change adaptation. This barrier was mentioned at the state, regional, and local levels.

Across the state, it was noted that there remains a general lack of awareness/understanding that climate change is happening now in Michigan, is having an impact, and will have worsening impacts

if current trends continue. People in Michigan think they are relatively safe when in fact the state/region faces its own unique set of issues. With this lack of awareness, and when weighed against other issues such as environmental health issues like per- and polyfluoroalkyl substances (PFAS) and lead in drinking water, priority goes to those issues because climate change seems distant. Even within climate change action, adaptation seems secondary to mitigation in the minds of some and receives less attention/discussion.

State and federal administration priorities also dictate attention paid to adaptation at the state level. Similarly at the regional level, organizational restructuring, reduced budgets, and shifted priorities can shape adaptation planning activity in communities. For example, one organization experienced a recent shift from active, hands-on technical assistance in community planning projects to a more general community education approach. The focus on process over implementation dictates the hands-on work possible in rural communities.

Related to limited funding and staff time, at the local level, adaptation cannot be prioritized when in competition with other public services. Politically, other, more acute issues take the attention of the limited power of elected officials.

4.3.2 Enablers

Interview responses expanded considerably on the survey findings, revealing a different picture of enablers than that of the survey.

Networks/collaboration

Five out of the six interviewees (all of those working directly in the County) listed strong collaboration and community networks as enablers for climate and health adaptation planning in Marquette County. At the regional, county, and local levels, existing collaborative efforts on other projects was reported to be a good base upon which to build for future collaborative projects. Within

the rural geography, players know the key stakeholders that are vital for getting people on board. At the city level, numerous community partners focused on addressing climate change provide a base of expertise and support with which to move forward. Further, organizations in the community like MSU Extension connect the community to the broader organizations working on climate issues at the state level.

Networks/collaboration as a rural enabler

Five out of the six mentioned networks/collaboration as being unique to rural areas. From a state perspective, with rural County government and watershed groups often involved in local planning projects, there appears an easier opportunity for regional planning than in highly urban areas. Similarly from a regional perspective, the commonality of regional collaboration lays to groundwork for regional adaptation planning.

Collaboration and networks build off another point revealed in the interviews and not the survey – local trust. On participant notes that with strong interpersonal community ties, “networks in a rural geography are less “professional” networks and more “interpersonal” networks.” Firsthand accounts of impacts and solutions may go farther than fact-based clips that get circulated in the media or that “experts” share. Relatedly, with these close interpersonal ties comes strong good group support. Rural residents and community leaders “see value in numbers” and are ready to support other leaders with whom they have a connection. Common collaboration and close interpersonal ties lead not only to collaborative work, but also improves communication between people living miles apart, which also may be unique to rural areas.

Interested/involved leaders

The leadership ability of many of the interviewed organizations was seen as an enabler for climate and health adaptation planning. At the regional level, two of the organizations cited their ability

to assist in the local community planning process and act as a facilitator for climate adaptation planning within the region. With strong, established existing presences, regional players can educate a broad community through planning. Similar to networks and collaboration, another participant noted that leaders at one organization that are closely connected with leadership (through being the same person or having close ties) at other organizations allows for a wide range of influence within the broader community, helping move adaptation planning forward among numerous groups.

At the state level, administration leaders are interested in addressing climate change impacts. Executive orders by the Governor addressing adaptation opened opportunities to build connections between state level partners as well as initiated momentum and energy outside of state government. Additionally, a generally increased awareness that climate change is a priority has enabled conversations and action among nonprofits and state organizations. The interviewees did not identify this as an enabler unique to rural areas.

Community interest

At the state and city level public support was mentioned as an enabler. The state can build on adaptative capacity at the local level to implement programming, and the city has public support for climate initiatives. Additionally, in a rural setting there may be fewer issues than in more densely populated areas making it is easier for the public to observe changes, identify the problem, and rally around one common issue.

Outside assistance

At the state level, federal funding was listed as an enabler for climate and health adaptation programming. Funding from the CDC allows the state to focus specifically on climate and health adaptation programming.

Staffing capacity

Also mentioned at the state and city levels was the existing staff capacity of communities. At the city level, they are able to commit some time to addressing it. At the state level, the existing capacity of the emergency response and preparedness sectors, already experts in natural disaster planning, are an asset for climate change planning. If the relation to climate change and health impacts can be made, the existing knowledge is there to address it from an emergency preparedness point of view.

4.3.3 New information revealed beyond surveys

While much of the interview findings mostly expanded on the survey results in some way, some new information was revealed. The interviewee information on barriers mostly fit in with and expanded on the existing categories, but new enablers were revealed.

Enablers

Greenspace/rural identity (geographical and cultural)

Noted frequently as something perceived to be an enabler for rural areas was the culture and geography of rural areas. This was mentioned by only one survey taker but mentioned with frequency and greatly expanded on in the interviews.

Rural culture was noted in both identity and in people's connection with the land. Rural residents were perceived to have a stronger connection with the land, water, and lakes than residents of other geographies. Participants noted that people see and experience changes very acutely because they are present in the landscape and experience impacts in a natural system. Adverse effects of climate change can motivate action. They understand the natural systems and water systems and how actions affect them. Interestingly, interviewees noted that climate change denial hasn't been experienced in the county.

Expanding on this connection, participants noted that rural residents tend to find identity in the land and take pride in the land and nature. In addition to that identity, rural residents maintain a strong sense of "hometown pride" and extend that pride in looking out for one another.

In relation to the human land connection or rural residents, participants noted the adaptive capacity of the land itself. The nature of rural areas' expansive green space can act as an inherent asset. Green infrastructure, which must be reintroduced to urban areas, naturally remains in place in rural settings.

Fewer to collaborate

One commonly mentioned enabler specific to rural areas was that with a smaller staff and smaller (population-wise) regional community, there were fewer people to convince and collaborate with in order to move forward with action. Given these smaller staffs and that many staff members wear many hats, action could move forward more quickly. It was noted that on a percentage basis rather than through sheer numbers, there may be more interest and engagement than seen in other geographies. While this wasn't mentioned as an enabler in any of the interviewed organizations, this was assumed to be an enabler for rural communities in general.

Access to and trust of local experts

A second newly revealed enabler specific to rural areas was access to and the community's trust of local experts. Participants noted that experts and other leaders with "local cred" are more readily available to work on planning projects. The trust held in them by the community can bring validity to a project to the people from the local area, while at the same time providing much needed expertise for a project. For one organization seen as a trusted local expert, the expectation by their employer that the employees be continually up-to-date on the information on particular topics helps connect up-to-date information to the community.

Publicity and relatability

Also mentioned as an enabler within organizations and not necessarily specific to rural areas was the recent publicity of the climate and health connection by national leaders, as well as its relatability to other existing societal concerns with existing advocacy such as equity (through environmental justice). This relatability allows other organizations to push climate and health in relation to their focus, such as an equity issue.

4.4 Summary of findings

Overall, the survey and interview findings unveiled an array of barriers and enablers for nonagricultural-based rural, coastal organizations and those areas in general. For the most part but not always, the surveys and interviews provided similar details to the same story. Table 12 compares the top responses from the survey and interviews.

The surveys and interviews both presented funding and staffing capacity/time as the main barriers to climate and health adaptation. The surveys also listed community interest and support as a top barrier, while the interviews pointed to a lack of organizational awareness, competing priorities, and political barriers as the third most common barrier. The interviews expanded on the top two barriers stating that beyond a general lack of funding for anything beyond mandated services, mismatched budget timelines, differing funding priorities between government levels, and a general lack of attention on rural communities can cause challenges to communities for climate and health adaptation planning. As far as staffing, rural counties tend to have few jurisdictions or organizations with enough planning staff (if any planning staff at all) to dedicate time to climate and health adaptation planning. Of those barriers identified as specific to rural areas, staff capacity, expertise and communication were the top three mentioned. While the interviews did not necessarily reveal any completely new barriers not mentioned in the survey, details on some of the responses, such as the independent spirit of the

residents, the general "brain drain" of educated residents, and the generally vast geography of service and communication coverage revealed the exacerbation of existing challenges for rural communities.

The enablers revealed in the interviews were considerably different from those identified in the survey. The survey responses showed that interested/involved leaders, community interest, and outside assistance were the top three enablers for climate and health adaptation planning. The interviews showed strong networks and collaboration, leadership, and community interest and support as the top enablers for the interviewee's organizations. For rural areas, the interviews identified strong networks and collaboration, a strong connection between humans and land, and easy access to trusted local experts as the top enablers. Some nuances revealed as enablers and not identified through the surveys were the connection rural residents have to the land and their sense of identity can garner interest and build neighborly support networks, the idea that the fewer public officials working in each jurisdiction makes it easier to get everyone necessary on board for action, easy access to and trust of local experts is helpful in gaining public support and support from local officials, and that the publicity and relatability of other issues to climate and health adaptation planning can get more people involved adding to support.

Table 12 Top barriers and enablers categorized by data gathering method

Top 3 Survey Barriers	Top Interview Barriers	Top Rural Barriers (I)	Top 3 Survey Enablers	Top Interview Enablers	Top Rural Enablers (I)
funding	funding	staff capacity	interested/ involved leaders	strong networks and collaboration	strong networks and collaboration
staffing capacity/time	staffing capacity/time	expertise	community interest	leadership ability	strong connection between humans and land
community interest and support	Lack of organizational awareness; competing priorities; and political barriers	communication	outside assistance	Community interest/support	easy access to and trust of local experts; fewer to collaborate

In general, the barriers and enablers revealed at the state, region, and local level were similar, although some trends relating to their jurisdictional affiliation could be noted. At the state level, bigger picture issues like administrative priorities and politics were expressed as barriers, while at the regional and local levels direct departmental concerns like staffing capacity were heavily noted. Concerns related to the general population trends for rural areas, such as a lack of expertise were noted at the regional level.

Similarly, trends for enablers observed by the region and local level were somewhat different than those seen at the state. For example, the observation of the strength of the local networks was identified by the regional and local experts, but not noted at the state level. Conversely, funding was only seen as a possible enabler at the state level, at not at any others. At the local level and state levels, public support was noted as an enabler, yet at the broader regional level it was not.

Chapter 5. Discussion

This chapter will discuss the key findings of this study in the context of the greater climate and health adaptation literature. It will discuss the implications for climate and health planning in a nonagricultural-base rural, coastal context. Additionally, it will cover the limitations of this study including how those limitations relate to other research and can lead to future research.

5.1 Similarities to Existing Literature

The survey and interviews both verified the findings of other researchers of the main barriers for climate adaptation planning and revealed barriers unique to a nonagricultural-based rural, coastal context. Consistent with the findings of other researchers (see (Eisenack et al., 2014; Measham et al., 2011; Moser & Ekstrom, 2010; Nordgren et al., 2016), this study found a lack of funding as the top barrier for climate and health planning in Marquette County. Also consistent with previous studies in Michigan, insufficient staffing/time capacity was the second biggest barrier (Nordgren et al., 2016). Also found in the literature as a major barrier but perhaps categorized slightly differently, the survey found the third largest barrier was a lack of community support/interest.

Other researchers have identified the majors enablers to be local adaptation champion pushing and carrying action; knowledge of the projected climate change impacts and a desire to protect local assets; the ability to uphold community values or advance local priorities (around natural resources or ecosystems, or a desire to revitalize the socioeconomic status of a community); climate-network support; and a desire to either act a leader in climate adaptation; or in response to published climate change information or extreme climate events (Berrang-Ford et al., 2011; Carmin et al., 2012; Hughes, 2015; A. C. Lesnikowski et al., 2011; Nordgren et al., 2016; Reckien et al., 2015; Vogel et al., 2016). Similarly, the survey responses showed that interested/involved leaders and community interest as the top two enablers. The third, outside assistance, may fall under the category of climate-network support.

The trends in the barriers and enablers observed at different jurisdictional levels are notable for the reason pointed to by other researchers, that context matters (Eisenack et al., 2014). While "context" generally refers to geographies and organizations, this study demonstrates that jurisdictional context can play a role in the barriers and enablers perceived within a single county.

5.2 Rural, coastal barriers and enablers for climate and health planning

While the findings were similar to the findings of other researchers, several challenges and opportunities unique to nonagricultural-based rural, coastal areas stand out for discussion. Many of these elements were revealed through interview conversations, although some of the survey responses highlight aspects unique to rural, coastal climate and health adaptation planning.

Nonagricultural-based rural, coastal areas clearly face a unique set of challenges in climate and health planning. While resources including funding and staff time can be an issue in any community, in rural communities this lack of resources is exacerbated and further disadvantages them in planning for climate and health. As the interviewees noted, without dedicated planning staff in most small jurisdictions, or enough staff to work on anything beyond day-to-day activities, there may not be time even to apply for grant opportunities when they become available. Rural communities will continue to be overlooked when scarce resources for climate and health adaptation planning are distributed, as grant funders seek locations with existing capacity to see a project through.

Another barrier unique to rural areas that must be considered is a large distance between people and the communication challenges that brings. Communication and community education for planners and health officials were mentioned as a barrier in the survey, and the geography factor with limited means for communicating was highlighted in the interviews. Urban areas, while generally facing larger numbers of people to serve, have an advantage in reaching people through traditional communication methods. Planning for climate and health depends on effective communication plans for

reaching everyone in a service area. With great distances and limited means for communication, remote residents are at greater risk of not being prepared for emergency events. An additional communication challenge mentioned in the interviews is brought on by the independent spirit of the residents, which acts as both a barrier and enabler. As a barrier, rural residents tend to resist help from outsiders, stalling action. While acting as an enabler, their independent spirit can reveal a determination and sense of community that strengthens them in resiliency.

A third barrier unique to rural areas is the general lack of expertise compounded by the out-migration of educated residents. Information necessary for climate and health planning is not necessarily reaching or readily available to those doing the planning. Local experts must stay informed on many topics and have limited time. Additionally noted by the interviewees is the "brain drain", in which educated residents move away from the rural areas, leaving behind a mindset reflecting that of the past, possibly not as concerned about seemingly abstract topics like climate and health. This mindset can create an additional barrier for community leaders as well as diminish the pool of possible leaders for addressing the concerns.

Rural, coastal areas also have unique opportunities possibly not seen in other places to help advance climate and health planning. Existing networks and collaborative activity lay the groundwork for action across a regional scale. Leaders in various communities and organizations are used to collaborative work and are willing to work together is necessary to get things done. They understand the need for and regularly practice working together on larger issues in order to get things done. For issues that cross many boundaries, such as climate and health, this existing foundation allows such collaborative work to be a relatively normal step and circumvents the trust-building process that may be necessary in other communities for regional work. As this enabler was noted by interviewees at the regional and local level, but not mentioned in the state level interview, it is worth noting that supporting collaboration at a higher level could help strengthen these networks in action.

Rural, coastal areas also have the advantage of residents with strong connections to the land and to each other. By being in tune to the changes and their lives more impacted by the elements, rural, coastal residents have some motivation to do something and prepare for the changes. With strong feelings of identity with the land and the community, residents support each other in times of crisis. These assets might not necessarily be found in urban areas, where residents are relatively protected from the elements and may not know their neighbors well.

While access to expertise and solutions relevant to rural areas was noted as a barrier, access to and trust of local expertise was noted as an enabler. With small communities, if experts living in the community such as MSU Extension or university professors are available to work with organizations, over time these experts are likely to gain the trust of the community. For experts located within rural communities, there may be fewer issues to focus attention on in comparison to urban areas. The established relationship between experts and community can ease the climate and health planning process.

5.3 Implications for climate and health planning in rural, coastal areas

The results of this study not only shed a light on the barriers and enablers to climate and health adaptation planning faced by nonagricultural-based rural, coastal areas, and how they are similar and different to other adaptation planning settings, but they also hold several key implications for climate and health adaptation planning. These implications can guide governance, funders, planners, and stakeholders in climate and health adaptation planning. While studied in a rural, coastal county in Michigan, the findings may have broader implications beyond Michigan and the Great Lakes region. States like California, Florida, Texas, etc. are all dealing with the health impacts of climate change in their resource-constrained rural, coastal areas, including at the county level. Small communities, rural and coastal or otherwise, are also facing similar constraints and opportunities to those found in

Marquette County. While each will have their own unique barriers and enablers to climate and health adaptation planning, many of the challenges and opportunities found here may likely also apply in settings across the United States.

5.3.1 Funding and technical assistance specific to nonagricultural-based rural communities

It is not unusual for rural areas to face barriers for any planning in terms of capacity and funding, as often the communities themselves don't have designated planning staff. For climate and health planning this challenge is no different. As voiced in the interviews, in these cases outside assistance become vital to successful planning and implementation. General grants to which any community can apply for climate and health planning action are not currently enough to serve the needs of nonagricultural-based rural areas. While funding for climate and health planning in general is not currently sufficient to meet demand, what exists is only valuable to those with the capacity to apply for it. Additionally, urban areas with high visibility may be more likely to win grant opportunities when funders seek projects which will have high and immediate impact with obvious recognition.

This issue could be addressed in two ways: 1) through funding opportunities targeted and available only to nonagricultural rural areas. As in the case of Marquette County, "rural" cannot be defined as "agricultural" or many rural areas may be excluded from the opportunity. 2) Through technical assistance for communities lacking planning staff or enough health department specialists. Without designated planning staff, rural communities lack the capacity to apply for larger grants and are often passed over for communities in which funders see existing capacity for implementing a project. While sensible from the funder's perspective, communities lacking the ability to take even the first step will continuously be left behind in the adaptation realm. Government funding that provides technical assistance for communities lacking planning staff would be one way to help these communities move forward with adaptation measures.

Specific to Marquette County, building on the existing regional networks to assist the smaller communities would be effective. While this is largely already done to some extent by existing regional planning organizations, recognizing this need and coming up with an actionable plan for assisting all the smaller communities would help move the adaptation needle forward for the entire county.

5.3.2 Policy Mandates through Hazard Mitigation Planning

For communities with limited staffing, mandated services can consume all of the community's resources. While mandating that adaptation measures be taken in any community services may be far-fetched, capturing adaptation measures in existing related planning through mandates is not. One way to approach this is by requiring that climate change and health be considered in Hazard Mitigation Planning. Compiling these plans already requires an extensive understanding of the community's interconnected systems and how the community can prevent major disasters. These plans currently look at historical climate data to plan for climate related events. By including future projections, and by giving weight to recent climate disasters (for example the frequency of 500-year and 1000-year flood events in recent years), these plans can relatively simply better prepare the community for the impending hazards seen with climate change. Incorporating data on the vulnerable populations of the community and how they may also be affected by climate change can also bolster these plans. By proactively accounting for these changes rather than reactively including them in these plans, communities can appropriately mitigate hazards.

Mandating collaboration across county organizations and including public health officials in the conversation for hazard mitigation planning could be additionally effective. As noted in the interviews, this type of collaboration is often happening at a less formal level. Capitalizing on this existing network could strengthen the knowledge going into plans, as well as the implementation of strategies.

Prior to policy mandates, Marquette County could strengthen their Hazard Mitigation Plan by ensuring that their climate and health adaptation goals as laid out in their climate and health plan are included in the next Hazard Mitigation Plan update. Working collaboratively across organizations, a practice already common in the county, can ensure that the plan is recognized, and the mitigation strategies implemented.

5.3.3 Establishing Trusted Experts at the Local Level

Access to experts trusted by the community has been an asset for climate and health planning in Marquette County, as identified in the interviews. For rural areas, building trust with experts can take time, and credentials do not necessarily equate to respect or trust. Programs like MSU Extension, which establish local experts in a community to act as a resource and connect the latest research/information to the local level can help keep rural areas connected with the latest best practices, available funding, etc. As it takes time to build rapport, nurturing ongoing collaboration with other community leaders can generate trust and a welcoming of knowledge. The expansion of Extension and similar programs which allow for the long-term establishment of experts in the community could help capitalize on this enabler for climate and health planning in rural communities.

For Marquette County specifically, utilizing their existing trusted local experts to the fullest and working to expand their presence could be effective in pushing climate and health adaptation action. For future climate and health adaptation grant projects, ensuring that the local leaders rather than outsiders are the ones speaking to the audience may be useful in cultivating buy-in. Funding that supports the ongoing education of existing leaders in climate and health adaptation planning and works to develop new, young leaders in the field could help sustain local trusted experts into the future.

5.3.4 Storytelling

Storytelling through before and after design visualizations of climate and health adaptation techniques in Marquette County has been one method of educating and engaging the public during the project associated with this study. While found so far to be effective in engaging the audience, several of the interviewees mentioned that in fact oral storytelling coming from local residents would be a good way to help move climate and health planning forward in a rural setting. Related to networks and collaboration, an independent rural spirit, and a sense of trust of local experts, stories from their own neighbors within the community can help people connect and relate to real life experiences and possibly help motivate them to action. Relating to the stories of residents with whom they share a community and history, rather than the facts and data of "experts" may be a way to communicate with the uninterested residents or leaders of rural areas.

While broadly applicable, Marquette County could use this technique in their planning processes around climate and health adaptation to expand education and buy in. With a distinctly complex topic such as climate and health, building on the internal trust of the community may make the topic more approachable to isolated residents.

5.3.5 Building on Existing Networks

This study revealed the clear importance of existing regional networks for nonagricultural-based rural, coastal areas in climate and health adaptation planning. Supporting this asset and building on these existing networks could be effective in strengthening adaptation planning and implementation in the area. This key finding could also be a crucial, unexplored asset in similarly resource-constrained communities across the United States searching for a way to approach adaptation. In the short term, Marquette County could enhance their planning by recognizing and capitalizing on this asset. More

widely, adaptation related funding could include contingencies for regional collaboration to ensure these assets are being established and strengthened.

5.4 Limitations and future research

Some limitations of this study prevent its generalization to a broader rural scale, but future research can build on the findings here. One limitation is simply the topic of the study and questions which can limit its relatability to other climate change planning research. Studies around climate change planning are approached from many different angles including mitigation, adaptation, urban areas, rural areas, barriers, enablers, plan content, policies, and the list goes on. This research focused specifically on climate and health adaptation planning, which is relatively novel in the climate change literature and adaptation/mitigation realm. The questions in the survey and interview narrow in on climate and health related questions and these questions act as the basis for the analysis of the results. Yet in the interviews the drift between the different aspects of climate change research and attention became clear as one participant referred several times to climate change mitigation actions rather than climate and health adaptation. It is not clear whether this confusion happened with survey takers. General education about the differences between adaptation and mitigation is still needed to ensure participants really understand what is being asked of them.

Another limitation of the survey realized through reviewing the results was the frequency of responses matching the example responses presented in the survey. In the question related to barriers "What are the top three barriers your community or organization faces in the implementation of the climate and health adaptation strategies presented today? (e.g. lack of funding; lack of leadership; insufficient staffing)", two of the three examples given ended in the top three most cited barriers. For enablers, the examples given were "interested leaders; existing outside assistance; strong community interest". These aligned with the top three enablers stated in the survey. Having the examples there

may have influenced the ideas that came to the respondent's minds during the survey. With the questions at the end of a 20+ question survey, it's possible that not as much thought went into the responses as may have if presented differently. A follow-up survey listing possible barriers and enablers and asking the respondents to rank their significance would be useful for verifying the results of this study or for future studies.

Another limitation was the perception of barriers and enablers specific to rural areas asked of the interviewees. Almost all the interviewees, other than the state health department official, work strictly in rural communities or small cities. Not active in the actions of more highly populated urban local governments or organizations, they may perceive factors to be unique to local contexts when in fact they may simply not have experienced them or heard of them elsewhere. Asking similar questions of similar urban actors is one way to address this in future research.

Chapter 6. Conclusion

This study attempted to identify some of the main barriers and enablers to climate and health adaptation planning and implementation in a nonagricultural-based rural, coastal county in Michigan. This was done through qualitative, exploratory research using open-ended surveys and interviews. The research revealed that the barriers and enablers faced in nonagricultural-based rural, coastal Marquette County are both similar to those found in other settings by researchers of adaptation planning and unique to this context. In situations where the findings mirrored those of other settings, the interviews clarified how these challenges and assets may be experienced differently from other settings. Clearly, nonagricultural-based rural, coastal areas face unique challenges to climate and health adaptation planning, such as large geographical areas and communication, for which the answers are not simple. They also have advantages for adaptation planning such as strong collaborative networks and immediate connections to the land not seen in other settings which can be capitalized on to ensure residents are prepared for the challenges ahead.

This study is the first to look specifically at the barriers and enablers to climate and health planning in a nonagricultural-based rural, coastal county in Michigan. While some of the findings may be unique to that specific setting, the results are likely applicable to a range of settings and communities across the United States. Nonagricultural-based rural, coastal counties in California, Texas, and Florida, experiencing drought, hurricanes, and wildfires are likely similarly resource constrained with large and remote geographies. Facing similar challenges, they too may have a strong collaborative network upon which to build. Small communities in urban counties may also face barriers in terms of minimal staffing and competing priorities, and yet may have similarly resilient populations willing to work together to take action. Noting that the context of this study was a community relatively advanced in adaptation planning further unveils the level of challenges faced by communities new to adaptation planning. If these challenges are experienced at this relatively advanced stage, it is likely that challenges for those

just beginning are likely greater. This study sheds a light on climate and health adaptation in resource-constrained contexts across the United States.

While this study only begins to explore the complexities of climate and health planning in a nonagricultural-based rural, coastal county in Michigan, it further reveals the findings of the Fourth National Climate Assessment, that much research remains to understand about how rural areas will deal with the challenges ahead (Gowda et al., 2018). Expanding research in this area is crucial for a wider understanding of how rural areas can approach adaptation needs. As the "stewards" of our natural resources (Calthorpe, 2010), research in rural areas is vital to the health of everyone. With 80% of the nonmetro counties in the United States (USDA ERS, 2015) being nonagricultural based and nearly 40% of the population living in counties adjacent to a shore (Kildow, Colgan, Johnston, Scorse, & Farnum, 2016), nonagricultural rural, coastal areas cannot continue to be overlooked as the rest of the country attempts to grapple with negative climate and health impacts.

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