

**Beyond Rising Seas: Understanding Climate Planning Challenges in Rural
Inland Florida**

By: Lacey Lingelbach

Email: laceyl716@gmail.com

School of Natural Resources and Environment

Advisor: Cynthia Barnett, College of Journalism and Communications

University of Florida's College of Agricultural and Life Sciences Honors Program

Acknowledgements

I would like to take a moment to recognize the people and organizations that assisted me along my undergraduate research journey. To my Askew Scholar mentor and thesis advisor, Professor and Journalist Cynthia Barnett, since I met you my sophomore year, you have inspired me to push myself and become an environmental leader. I appreciate the time you took to encourage, edit, and advise me as I navigated this difficult, ambitious project. I believe your support brought this project to a higher level and made me a better writer.

I would like to express my gratitude to the Bob Graham Center for Public Service and the Florida Climate Institute for sponsoring this project. Also, I am grateful to the UF/IFAS Extension and Florida Sea Grant staff that shaped my insight on climate change in Florida. Interning with your group inspired me to pursue this project and a career in empowering local communities. I would not have the data and information I needed to explore this topic without you. Likewise, I want to extend great appreciation for all local government employees who responded to the needs assessment survey despite the difficulties added in doing so from the COVID-19 pandemic. Your local knowledge is invaluable to a project like this and I hope this research aids your future climate efforts.

Many thanks to the professors and staff in the School of Natural Resources and the Environment for providing me the tools and skills to deploy interdisciplinary thinking for environmental solutions. Particularly, I appreciate the support of my academic advisor Karen Bray, who has worked with me since I started at the University of Florida to make sure that I took advantage of all the opportunities available, including this research project.

Lastly, I would like to thank my personal cheerleaders and supporters, Joe and Debra Lingelbach, Isabel Rivera Santiago, Anna Zamolodskaya, and Lauren Cook, for listening to my ideas and frustrations, providing happy restful distractions, and constantly checking in. During difficult times, your optimism and belief in my abilities reminded me of my passion for and knowledge of local climate resiliency.

Table of Contents

ABSTRACT	4
INTRODUCTION	5
MATERIALS AND METHODS	8
RESULTS & ANALYSIS	11
Challenge One: Community Sentiment	11
Challenge Two: Investment Capacity	18
Challenge Three: Gaps in Climate Literacy	22
Challenge Four: External Connections and Coordination	26
IMPLICATIONS OF THE RESULTS	32
Recommendations for Local Governments	32
Recommendations for Community Stakeholders and Organizations	36
Recommendations for External Actors	38
CONCLUSION	42
REFERENCES	45

Abstract

Despite being farther away from direct impacts of sea-level rise, Florida's rural inland localities, like those across the nation and world, can be as vulnerable to a changing climate as coastal ones. However, unlike their urban coastal peers, many have not addressed or acknowledged climate change. Few existing research projects have explored the reasons why. To begin understanding the complexities of the rural Florida climate story, this research aims to answer the question: What challenges are preventing rural inland communities in Florida from addressing climate change and what do they need to overcome them? To characterize these obstacles and identify next steps, a combination of primary sources (i.e. surveys of local governments and rural voters) and secondary sources from the author, government agencies, scientists, universities, and other expert organizations were analyzed holistically. The four challenges identified include: community sentiment, investment capacity, gaps in climate literacy, and external connections and coordination. These challenges are linked to numerous underlying issues characteristic of rural communities, such as socioeconomic levels, physical and social isolation, the availability of human capital, and cultural values and perceptions. Based on this information, the implications section reviews how local governments, community members, and external supporting agents can actively curtail disparities in climate preparedness.

Keywords: climate change, climate action, rural, Florida

INTRODUCTION

Changes to the climate are already causing social, economic, and environmental disruptions in communities across Florida (Environmental Protection Agency [EPA], 2016; UF Bob Graham Center [BGC], 2020). In the last few years, numerous tropical storms, such as Hurricane Michael, hit Northwest Florida (Ramos & Renne, 2020). As both inland and coastal areas worked to recover from these storms, they experienced economic and social stressors from reduced tourism revenue, agricultural crop losses, and widened wealth gaps (BGC, 2020). Although the extent and timing of these climate disruptions in Florida range in levels of certainty, climate models project impacts will escalate alongside increasing temperatures, rising sea levels, warming oceans, variable precipitation and drought events, and intensified tropical storms (Carter et al., 2018; EPA, 2016; Runkle et al., 2017).

With the majority of the state's lands and natural resources, rural inland communities of Florida are of critical concern for a shifting climate (Grant & Bonveccio, 2019; Hauser & Jadin, 2012). Over half of Florida's counties are considered rural with concentrations in the state's Panhandle, North Central, and South Central regions (Grant & Bonveccio, 2019; Office of Policy Planning, 2018). Generally, they are less populated, fairly distant from metropolitan areas, and dependent on natural resource-related industries, such as forestry in North Florida or citrus in South Central Florida (BGC, 2020; Grant & Bonveccio, 2019; Hauser & Jadin, 2012; USDA Economic Research Service, 2021). According to the Barometer Florida Project (2020), the most socially vulnerable regions in the state are North Central, West Central, Northeast, Central, and Northwest Florida. Within these regions, the rural inland counties, such as Madison, Hardee,

Suwannee, Dixie, and Jackson, have the highest social vulnerability indices.¹ This social vulnerability can be attributed to high poverty rates, older populations, lack of affordable housing, isolated transportation networks, and poorer access to healthcare (BGC, 2020; Hales et al., 2014).

Climate models forecast these localities enduring direct and indirect consequences affecting their economic livelihoods and exacerbating existing socioeconomic challenges (BGC, 2020; Hales et al., 2014). Examples of such repercussions include:

- **Climate Migration.** As coastal populations are displaced, they are predicted to in-migrate to inland communities across the United States (Hauer, 2017). Available open land or cheaper properties in low-income areas may be developed to provide shelter for them. As a result, gentrification can occur and push out impoverished residents; while access to water, energy, and food is further constrained (EPA, 2016; Hales et al., 2014; Nathan, 2019).
- **Intensified Storm Events.** With the intensification of tropical storms, rural inland areas are at-risk for inland flooding and wind damage (Ramos & Renne, 2020). Older telecommunication, energy, and transportation infrastructure may be damaged during storm events, which can detach communities from outside resources and prolong recovery (Hales et al., 2014). Also, the uncertainty of impacts complicates the adaptation and protection of agricultural and natural resource commodities (Her et al., 2017).

¹ The social vulnerability index measures the extent of social conditions within a community, such as poverty, access to transportation, and human suffering. According to the CDC National Environmental Public Health Tracking Network, this index ranks each community based on 15 social factors under the themes of socioeconomic percentile vulnerability, household composition/disability percentile, minority status/language percentile, housing/transportation percentile.

- **Extreme Heat.** In Florida, the general trend for the number of extreme heat days has increased since the 1970s (BGC, 2020). Since the ocean regulates surface temperatures, non-coastal communities are particularly exposed to extreme heat effects (Bausback, 2020). Higher temperatures influence rural working conditions and health, as evidenced by the highest 2018 state average emergency room visits for heat-related illnesses occurring in Northwest and North Central Florida (BGC, 2020). More frequent extreme heat days are presumed to negatively affect rural Florida's tourism, recreation, agricultural, forestry, and fishery industries as well as intensify health issues for vulnerable populations such as outdoor workers and the elderly (Carter et al., 2018; Her et al, 2017).

Therefore, although climate change is a global issue, its impacts occur at multiple scales. While international and national actors work to understand the large-scale complexities of the problem, stabilize global emissions, and ease under-resourced territories into a new climate reality, local ones can build their resiliency through mitigation and adaptation actions as well as engaging community members (Dzaugis et al., 2017). The goal of mitigation is to reduce or stabilize greenhouse gas emissions, whereas adaptation attempts to minimize the magnitude of climate effects (Dzaugis et al., 2017; Lingelbach et al., 2021). Since local public and private actors are ingrained in the dynamics of the community, they serve a key role in implementing such activities (Clayton et al., 2016).

The Problem with Climate Action in Florida

Rural communities across the United States are struggling to adapt to a changing climate (Carter et al., 2018; Hales et al., 2014). The Bob Graham Center's Barometer Florida project of 2020 examined the climate vulnerabilities and planning or lack thereof in all 67 counties of Florida. The project found that, despite being vulnerable to various climate risks, rural counties

tend to be less prepared than their urban counterparts. Exemplifying this conclusion, a study by Ramos and Renne (2020) revealed weak to moderate levels of hurricane preparedness in rural inland counties of the Florida Panhandle and South Central regions. Some Central and West Central rural counties invest in infrastructure to adapt to extreme weather impacts, such as heavy rainfall, or enact energy conservation strategies (BGC, 2020). Yet, largely, there is little to no organized climate action in these rural areas, especially in North Central and Northwest Florida, where only Alachua, Leon, Gulf, and Levy counties have local resilience officers or conducted vulnerability assessments (Bausback, 2020; BGC, 2020). Hence, rural inland Florida has climate resiliency challenges that can aggravate social, economic, and physical vulnerabilities.

Research Goals and Objectives

Research on the gap between coastal and inland climate action is limited. The 2020 Barometer Florida project described only county-wide initiatives, while other studies on rural inland climate connections are mostly conducted at the national level. This research serves to frame the rural Florida climate story and identify areas for potential support, engagement, and research. Through the analysis of community perspectives and existing data, the paper answers the question: What challenges are preventing rural inland communities in Florida from addressing climate change, and what do they need to overcome them?

MATERIALS AND METHODS

Over the past year and a half, these quantitative and qualitative materials were collected as the author carried out other academic research projects related to local climate resiliency in Florida. Each source was evaluated according to the following criteria: (1) reputability and reliability, (2) publication date, and (3) relation to rural areas or local climate science and policy.

Resources were published within the last decade from scientific journal articles, government agencies, university research, and scientific and nonpartisan organizations. Their data collection methods were reviewed for biases and proper research procedures. Also, abstracts and executive summaries were annotated to determine the relevancy of materials to the research's scope. The following are the main sources for which this paper is based.

- **Florida Local Government Climate Policy Needs Assessment Survey.**² The author created this survey for UF/IFAS Extension and Florida Sea Grant to understand local government climate attitudes and resource needs. From May to July 2020, it was administered via the Qualtrics platform to counties and incorporated municipal governments across Florida. It contained 24 questions on socioeconomic and geographic characteristics, climate science knowledge, level of concern, implemented climate policy actions, operational challenges, and interests in climate planning resources. In total, a diverse group of representatives from 128 Florida counties and municipalities of varying population sizes completed the survey. At least one county and one municipality responded from each region of Florida, with the majority derived from the Southeast, Tampa Bay, and East Central areas.³
- **Bob Graham Center's 2020 Barometer Florida Project.** Along with other undergraduate Civic Scholar's chosen for the Barometer Florida project, the author analyzed local climate impacts and actions in Florida's 67 counties. This report provided information on health, climate, vulnerability, and community as well as regional data snapshots.

² Throughout the paper, the survey will be referred to as the needs assessment survey.

³ These regions were based on the Florida Regional Planning Council jurisdictions.

- **Other Primary and Secondary Sources.** Research from other credible sources added information relating to the characteristics of rural localities, best practices for climate action, roles of external agents in local practices, and local case studies in and outside of Florida. Particularly, surveys from Duke University, Yale Climate Communications, and Pew Research provided national and statewide rural perspectives on climate change; and the 2014 National Climate Assessment presented general climate trends and projections for rural communities across the United States.

For the purposes of this paper, rural inland communities are defined as those in (a) non-coastal rural counties with 125,000 people or fewer, or (b) coastal, suburban, or urban communities at least 20 miles from the coast with an average population between 5,000 to 10,000. The needs assessment survey and the Barometer Florida tool both helped identify prominent barriers to implementing climate strategies and feedback on possible solutions. From the examination, challenges were grouped into four themes. Then, feedback from survey data in these two projects, research on climate solutions, community case studies, and advice from climate policy experts were considered when designing the recommendations.

Since these materials were not specific to rural inland Florida or at least small communities within Florida, a subset of the survey's data was sectioned into responses for areas with populations between 0 and 5,000.⁴ When comparing the results of this subset to those of the general survey, no discrepancies between the conclusions were found. So, the general dataset is referred to throughout the paper. Additionally, the other materials related to rural stakeholder perspectives and case studies contextualized the conclusions to rural Florida specifically.

⁴ There were some coastal communities included in this data subset that limits the applicability to all rural inland areas.

RESULTS & ANALYSIS

What challenges are preventing rural inland communities in Florida from addressing climate change? Results suggest four common issues encountered in undertaking climate action:

- Community Sentiment
- Gaps in Climate Literacy
- Investment Capacity
- External Connections and Coordination

The following characterizes each of these challenges and analyzes their possible causes. Given that they share similar elements, each one builds upon the others in a complex cyclical relationship.

Challenge One: Community Sentiment

Public sentiment and political will are essential components to climate policymaking. Generally, Floridians and public servants are aware of changes in the climate and concerned for impacts. According to the 2020 Yale Climate Opinion Map, 72% of adults in Florida think global warming is happening, which matches that of U.S. adults (Marlon et al., 2020). Also, as displayed in Figure 1, 63% of responses to the climate prioritization question on the needs assessment survey designated it as a ‘moderate’ or ‘high’ priority for their local government. However, the attitude towards climate change and its local consequences varies between rural and urban communities.

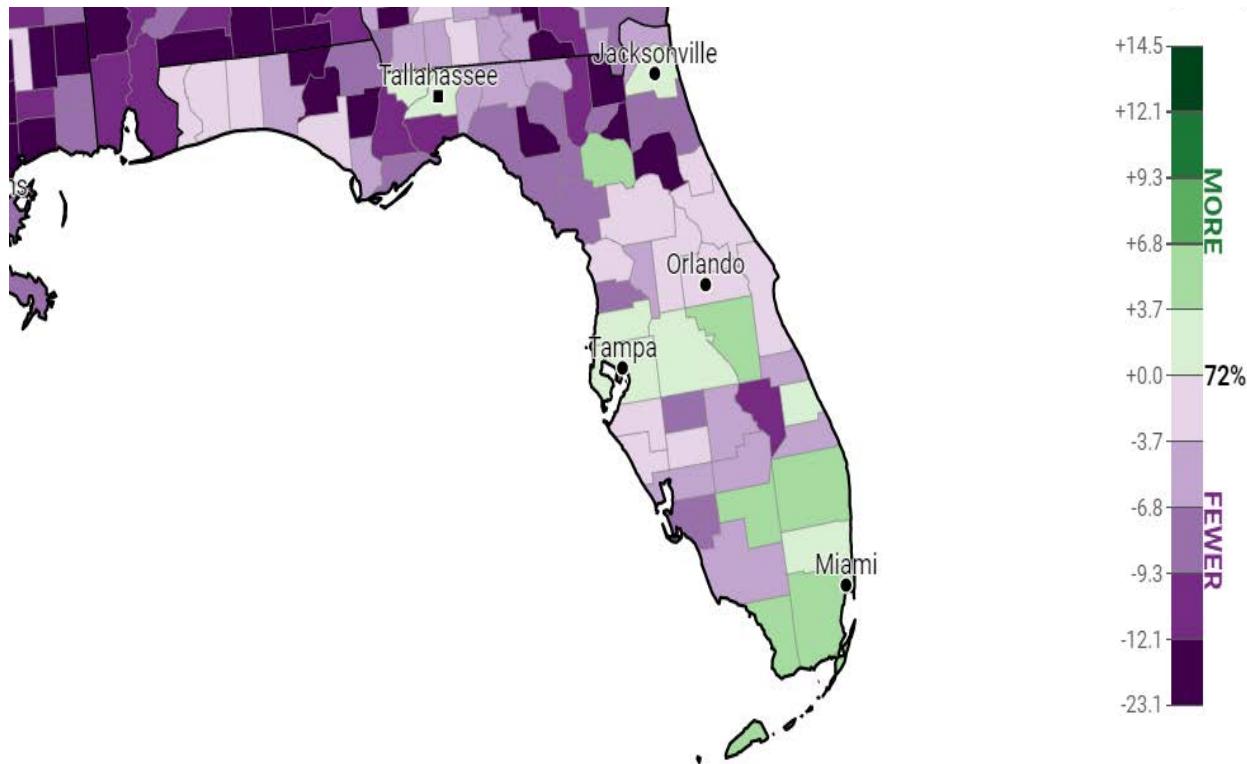
Figure 1. The Priority Level of Climate Change in Florida Municipalities and Counties



Note. This breakdown bar illustrates the distribution of local priority levels in regards to climate change according to the needs assessment survey. Adapted from “Florida Local Government Climate Policy Needs Assessment Survey” by L. Lingelbach, 2020. Copyright 2020 by UF/IFAS Extension and Florida Sea Grant.

Highlighted as dark purple in Figure 2, rural inland counties in North Central (Baker, Bradford, Lafayette, Putnam) and Northwest Florida (Calhoun, Holmes, Washington) are most doubtful of global warming. In contrast, urban centers depicted in green, such as Jacksonville, Miami, and Tampa, are most accepting of it (see Figure 2). Although the City of Orlando deviates from this trend, it is only by -1 percentage points (Marlon et al., 2020). In a similar manner, rural adults in Northwest and North Central Florida discuss global warming less often than their urban and coastal peers (Marlon et al., 2020).

Figure 2. Maps of Adults in Florida Who Think Global Warming is Happening



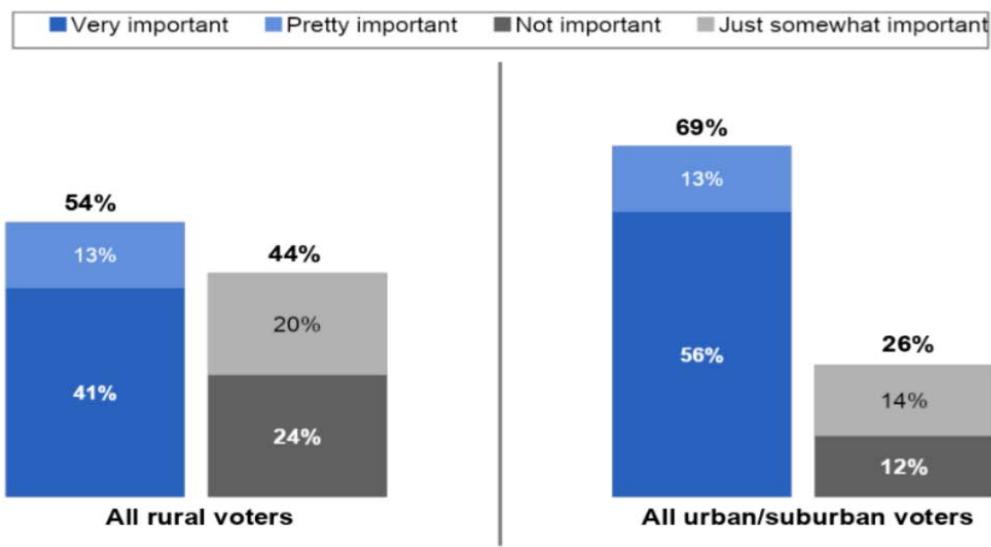
Note. The map shows the difference between adults in Florida and the national average (72%) who think global warming is happening. Purple areas are below the average, and green areas are above it. The darker an area is to these colors means they are more or less in agreement with the national average. From *Yale Program on Climate Change Communication*. (<https://climatecommunication.yale.edu/visualizations-data/ycom-us/>). Copyright 2020 by Yale Program on Climate Change Communication.

Furthermore, Figure 3 reveals that although rural voters in the United States support national climate action, urban and suburban ones place higher importance on it. In the needs

assessment survey (2020), small communities of rural counties, such as Franklin and Desoto, as well as coastal ones, such as Volusia and Duval, denoted climate change as a low to non-priority issue for local governments. Opposite of their urban and suburban peers, U.S. rural residents rank other environmental issues, such as clean water and farmland conservation, as more critical than climate change (Pechar Diamond et al., 2020). Thus, the research suggests that, compared to urban or coastal areas, rural inland Florida has lower public sentiment and political will for climate planning.

Figure 3. The Importance of U.S. Climate Action to Rural and Urban Voters

How important is it that the United States take action to reduce climate change?

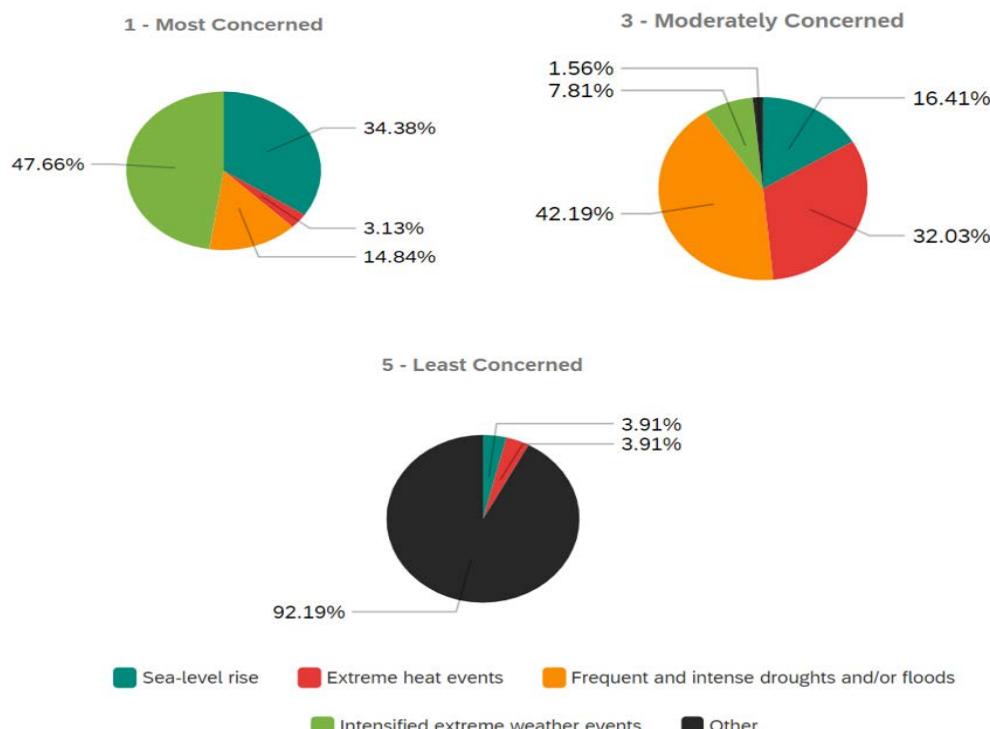


Note. Looking at the left blue bars in each graph, this bar graph shows that more urban and suburban voters value national climate action than rural ones. From “Rural Attitudes on Climate Change: Lessons from National and Midwest Polling and Focus Groups” (p.6), by E.Pechar Diamond, R. Bonnie, and E. Rowe, 2020. Nicholas Institute for Environmental Policy Solutions. Copyright 2020 by Nicholas Institute for Environmental Policy Solutions.

Despite common beliefs of rural climate opinions, disinclination towards climate policy does not mean that rural Floridians “deny” climate issues. The needs assessment survey (2020) asked participants about their localities impressions of climate-related projections and impacts. As shown in Figure 4, the highest concern (47.66%) is for intensified extreme weather events, like tropical storms, particularly for North Central and Northwest rural interior governments

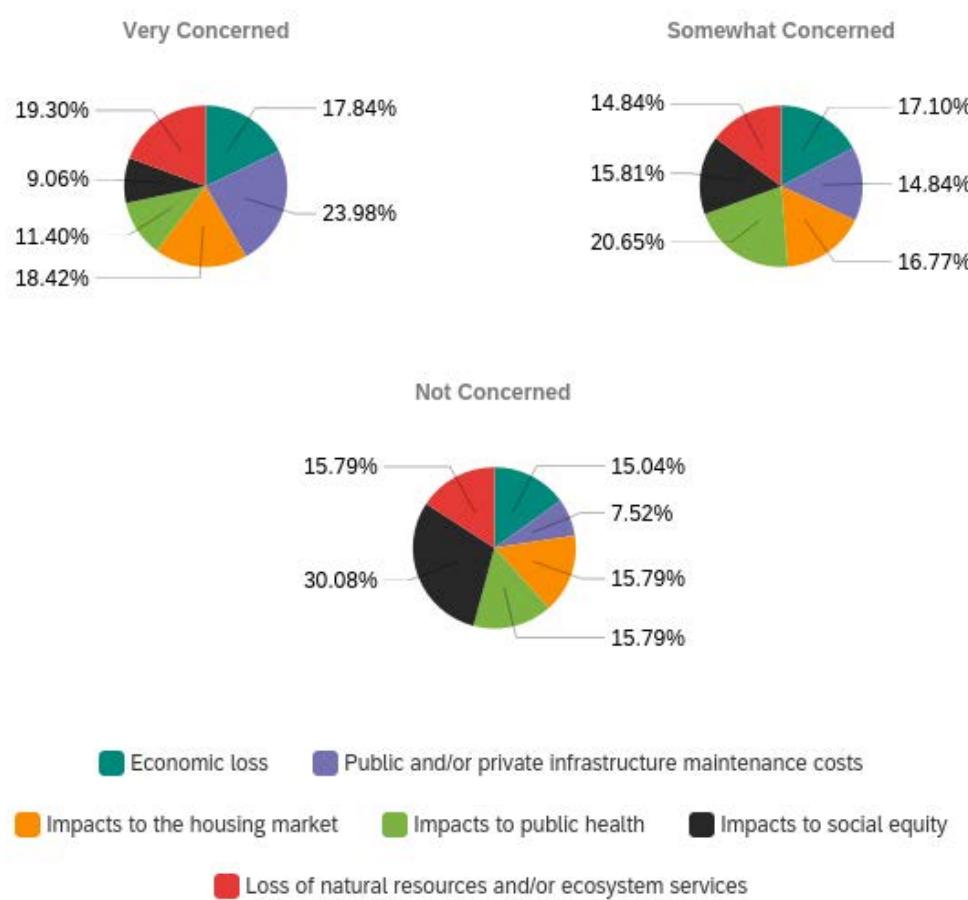
(Lingelbach, 2020). Likewise, Figure 5 presents the social, economic, and environmental ramifications of grave significance to Florida communities, notably increased costs to maintain infrastructure (23.98%), loss of natural resources or ecosystem services (18.42%), and economic loss (17.84%). Although these results are for all Florida governments, rural residents are likely interested in such impacts as they support climate change policies addressing extreme weather events and offering economic aid to farmers (Bonnie et al., 2020). Rural attentiveness to these climate-related issues often derives from commitments to protect the natural resources on which they economically depend, as well as consciousness of high vulnerabilities (Bonnie et al., 2020; Pechar Diamond et al., 2020). Hence, rural communities have sophisticated climate opinions in which they care about potential impacts but do not see necessity in addressing them immediately.

Figure 4. Level of Concern for Climate Projections amongst Florida Local Governments



Note. These pie charts show the concern for various climate projections according to responses on the needs assessment survey. The black portions refer to other projected changes not encapsulated by the options, such as intensified wildfires and increased ocean acidity. Adapted from “Florida Local Government Climate Policy Needs Assessment Survey” by L. Lingelbach, 2020. Copyright 2020 by UF/IFAS Extension and Florida Sea Grant.

Figure 5. Level of Concern for Climate Change Impacts among Florida Local Governments



Note. These pie charts show the concern for various social, economic, and environmental impacts of changing climate according to responses on the needs assessment survey. Adapted from “Florida Local Government Climate Policy Needs Assessment Survey” by L. Lingelbach, 2020. Copyright 2020 by UF/IFAS Extension and Florida Sea Grant.

What factors contribute to the lack of urgency in rural climate attitudes?

(1) Perception of Climate Risks

Since rural communities have a high tolerance of risks from frequent exposure, many residents characterize climate change as a future or nonexistent threat (BGC, 2020; Hales et al., 2014; Hauser & Jadin, 2012). Cognizance of current or likely climate risks is influenced by many social, geographical, economic, and cultural factors (Sikder & Mozumder, 2019). Particularly, the closer people live to the coast, the more they perceive climate change affecting

their community (Kennedy, 2020). Although no Florida communities are more than 300 miles from a coastline, perception of climate affects decreases after 25 miles – the typical distance of rural inland localities even in coastal counties (Kennedy, 2020). At this distance, their exposure to coastal impacts, like sunny-day flooding, are significantly reduced. So, it is difficult for them to see the prevalence of climate change in their community, especially when such coastal risks dominate Florida's climate narrative (Lingelbach, 2020). Yet, the omnipresence of a changing climate is increasingly revealed to these areas through extreme weather events that shifts their place identity, akin to tropical storms in Northwest Florida (Bonnie et al., 2020).

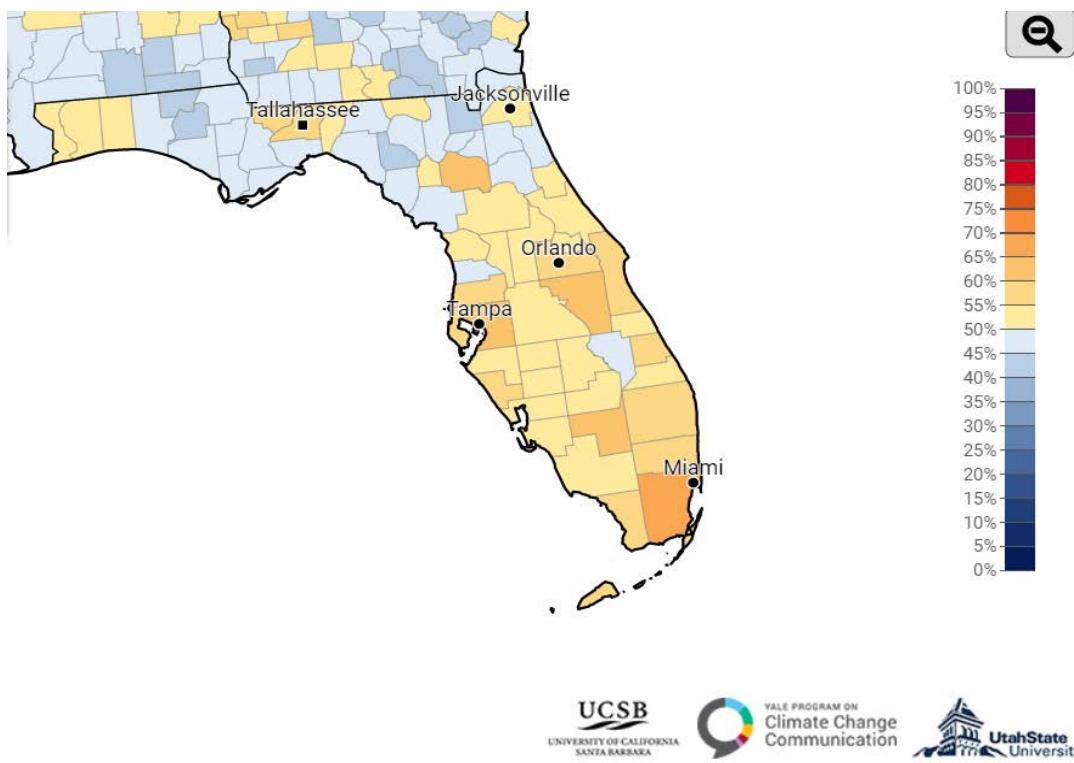
(2) Disconnect between the Community and Climate Science

Diverging views on the science of climate change, especially human causes and effects, reduce support for climate policies (Vannio & Paloniemi, 2013). Despite experiencing weather-related impacts, rural residents are often skeptical of its connection to climate change (Lingelbach, 2020; Pechar Diamond et al., 2020). As depicted by the blue areas in Figure 6, less than 50% of adults in most northern rural areas of Florida do not think global warming is primarily caused by human activities (Marlon et al., 2020). Similarly, a study by Duke University discovered that 50% of Midwestern rural voters attribute climate change to natural causes, do not believe that it is happening, or were not sure of its causes (Pechar Diamond et al., 2020).

Disagreements over climate science involve available knowledge, political characteristics, and trust in external experts. Due to inherent climate uncertainties and knowledge gaps in local-level impacts, information on climate science is perceived as inaccurate or unrelated to current everyday rural lives (Hales et al., 2014; Lingelbach, 2020). Political views exacerbate such notions. For instance, 83% of Democrats or Democratic-leaning independents

perceive climate change impacting their own community compared to 37% of Republicans and Republican-leaning independents (Kennedy, 2020). Polarizing views on climate change associate it as a political, not scientific, issue (Bonnie et al., 2020; Hauser & Jadin, 2012). Furthermore, weak relationships with climate scientists and strained ones with federal regulators lowers rural receptiveness to climate information (Bonnie et al., 2020).

Figure 6. Adults in Florida Who Think Global Warming is Caused Mostly by Human Activities



Note. The map shows the attribution of humans to climate causes among adults in Florida. Blue areas depict those that are less convinced of human causes. From *Yale Program on Climate Change Communication*. (<https://climatecommunication.yale.edu/visualizations-data/ycom-us/>). Copyright 2020 by Yale Program on Climate Change Communication.

Overall, rural communities have dynamic climate opinions. On one hand, they value environmental protection, are wary of their vulnerabilities to impacts, and support policies that address their specific needs. In other words, they see changes in the climate as a potential problem. On the other hand, the salience of the issue amongst those in the community is lower

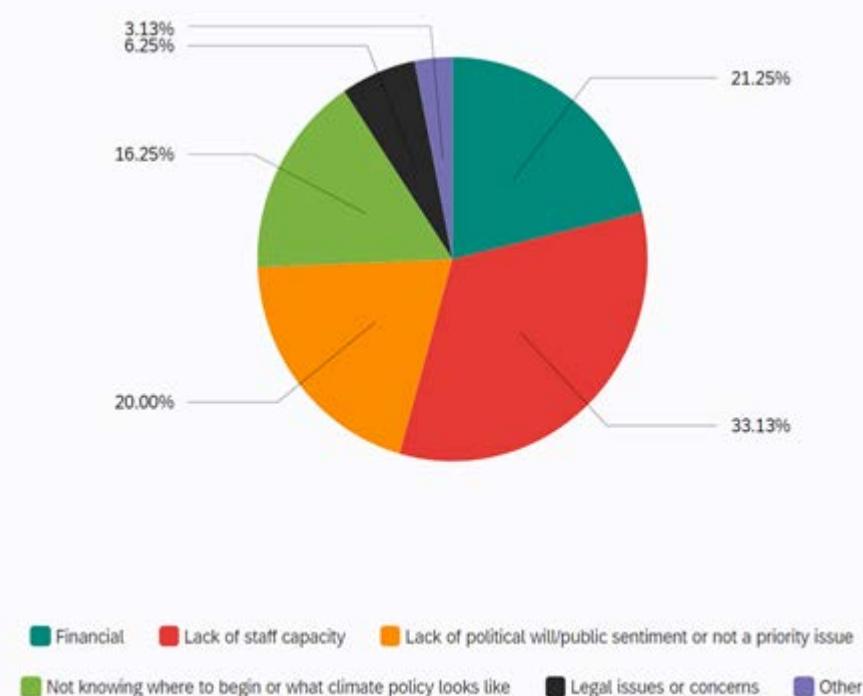


than that of urban or suburban areas. Without recognizing it is a current crisis, public and political actors are not motivated to take action.

Challenge Two: Investment Capacity

Whether it is holding a community engagement event, building new or repairing old infrastructure, or creating an emissions reduction program, climate action requires varying investments of both human and financial resources. As pictured in Figure 7, deficient staff (33%, red) and financial capacity (21%, blue-green) pose the largest barriers to climate planning at any stage of the policy process. Financial hardships have already halted climate adaptation projects altogether (Lingelbach, 2020). Relative to urban areas, rural local governments and community organizations struggle more because they have less available investment capital (Hales et al., 2014).

Figure 7. Barriers to Implementing Climate Action in Florida Local Governments



Note. This pie chart shows the barriers to local government climate action as identified in the needs assessment survey. Adapted from “Florida Local Government Climate Policy Needs Assessment Survey” by L. Lingelbach, 2020. Copyright 2020 by UF/IFAS Extension and Florida Sea Grant.

With an average 0.081 persons per acre, Florida rural counties are less populated and have smaller tax bases (Office of Policy Planning, 2018). Since local taxes are one of the primary ways local governments generate revenue, their budgets tend to be more constrained than suburban and urban areas (Hales et al., 2014). Rural counties in Northwest and North Central Florida, such as Union, Holmes, and Baker, are below the statewide average per capita revenue of \$3,515 (Florida TaxWatch Research Institute, 2019). Scant financial resources mean fewer departments and employment of fewer staff members. According to Hales et al. (2014), only 29% of rural counties studied had one or more planners compared to 73% of metropolitan counties. The typical makeup of small towns and cities in Florida is a legislative body, an administrator, a fire and/or a police department, and a few other community-serving departments (e.g. utilities, building, parks and recreation). Since each of these roles is highly involved, designating a new staff member to climate planning may overwhelm daily activities. Despite their larger administration, rural counties also lack expendable income to assign new staff roles.

With a self-sufficiency ethos, local rural residents and businesses often provide services in place of the local government, including business-sponsored landscaping; all-volunteer fire departments; faith-based educational programs, (BGC, 2020; Hales et al., 2014). Their willingness to supplement the government is often linked to their strong sense of place, history in the community, and/or connection to the land (Pechar Diamond et al., 2020). So, these community stakeholders have the potential to expand human capital available for climate action. However, their sentiment towards climate change affects how they decide to spend their limited resources (Hauser & Jadin, 2012).

What factors contribute to strained rural investment capacity?***(1) Existing Socioeconomic Difficulties***

In Florida, the rural poverty rate of 18.8% is higher than the urban one of 12.6% (USDA Economic Research Service, 2021). Additionally, most rural counties have lower per-capita incomes than the statewide average of \$47,684, such as Gilchrist with \$33,266 and Lafayette with \$24,767 (Florida TaxWatch Research Institute, 2019). Poverty and related issues prevent rural citizens, especially historically marginalized ones, from committing sufficient time or financial resources to attend public meetings, learn details about community issues, or participate in community volunteering (Grant & Bonveccio, 2019; Hales et al., 2014).

Economic and social disparities with immediate, observable impacts are of high priority to rural policymakers and community members (Hales et al., 2014). To reduce economic disparities, governments dedicate staff and funds to economic development incentive programs. For instance, the City of Live Oak and Suwannee County partnered to implement a business incentive program that expands existing and recruits new operations within the community (City of Live Oak, 2019). Similarly, social poverty increases the recovery costs of weather-related disasters for rural Florida, as seen by Northwest Florida residents such as those in Gadsden County still struggling to recuperate from Hurricane Michael in 2018 (BGC, 2020). As resources become available, communities dedicate them to short-term solutions for disaster redevelopment. Thus, in both situations, scarce resources remain to address long-term resilience.

(2) External Aid

Additional resources can be provided to communities by county, state, regional, federal, and statewide public and private actors. Yet, rural communities' physical and digital isolation makes it difficult to receive or know about such opportunities, especially grants, loans and other

funding opportunities (Grant & Bonveccio, 2019). Also, some external agents create resources only for coastal areas. To clarify, state resilience planning and implementation grants are given to communities that have a coastal management element in their comprehensive plan (Florida Department of Environmental Protection, 2020). Inland areas including Putnam and Bradford counties do not have this component in theirs. So, expanding financial resources and staff capacity is even more difficult without the help of outside groups.

(3) Awareness of Innovative Solutions

Many climate solutions are framed as large-scale urban investments by advocacy groups, scientists, and the federal government. For example, a common mitigation suggestion is to improve access to public transit and create bike-sharing programs. These are somewhat impractical since rural communities do not tend to offer public transportation options. While adaptation actions will require hefty investments, localities can choose to enact solutions that fit the needs, priorities, and resources within the community. However, according to the needs assessment survey (2020), small local governments are unaware of such climate strategies.

Ultimately, financial and human resource shortages reduce rural investment capacities for resilience. The small institutional capacity of local governments and community organizations forces them to prioritize policies that address immediate needs. So, community sentiment plays an important role in investment decisions. Likewise, external agents can increase the availability of capital. Taking advantage of these opportunities is critical because waiting to invest can be more costly in the long-run (Grant & Bonveccio, 2019).

Challenge Three: Gaps in Climate Literacy

It is neither necessary nor realistic for everyone to be an expert in climate science, especially when scientists dedicate their entire professional careers to studying its complexity (Hales et al., 2014). Yet, those who are climate literate gain a fundamental understanding of the ways in which climate and humans influence each other, the modelling of these interactions, and the interpretation of climatic and vulnerability data collected from these models (National Oceanic and Atmospheric Administration [NOAA], 2014). With basic climate knowledge and learned technical skills, leaders and individuals can better acknowledge and prepare for local climate problems (NOAA, 2014).

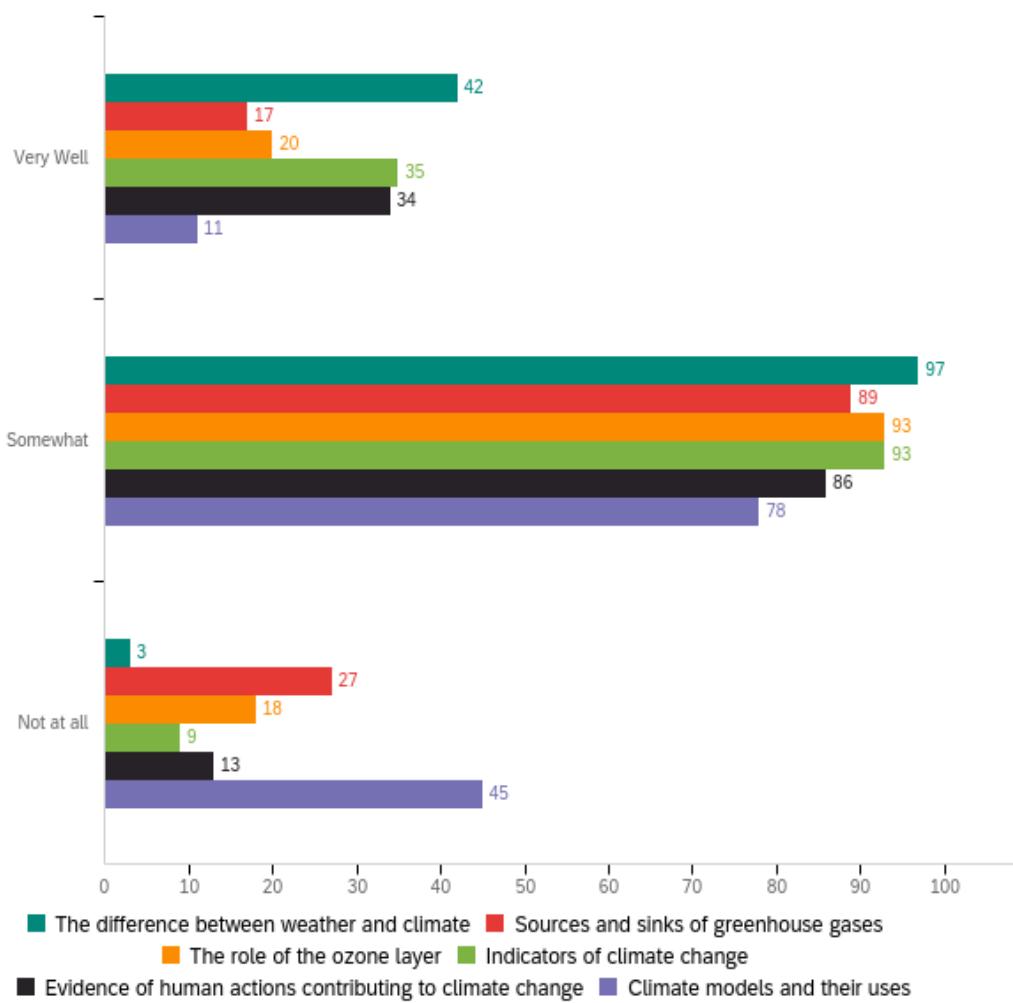
Since their livelihoods are intertwined with the natural environment, rural individuals are generally well informed about environmental issues occurring in their surrounding ecosystems (Hauser & Jadin, 2012). In fact, a focus group study by Duke University observed rural voters' high-level understanding of water conservation tactics in arid Nevada and of wildfire risks in wilderness Montana (Pechar Diamond et al., 2020). Moreover, people within local government and the community possess technical skills honed using environmental and climate data. For instance, agriculturalists rely on weather and climate information related to temperatures, rainfall, and humidity to make decisions related to their crops (Pechar Diamond et al., 2020). Utility workers use weather forecasts and models on extreme floods, storms, and temperature events to prepare for infrastructure impacts and changing electricity or water demands.

In spite of this general understanding of environmental issues, rural climate knowledge is weaker in three main areas concerning climate resiliency.

- **Human Influences on the Climate.** A majority of local governments responding to the needs assessment survey reported only a rudimentary comprehension of most climate science

principles (see Figure 8). Some notions, namely sources and sinks of greenhouse gases, are less understood than others. As established in challenge one, rural residents typically do not associate local actions and life with the effects of climate change. So, it is likely that rural areas, especially, are unfamiliar with anthropogenic climate feedback loops and misinformed on the effects of their actions on climate change.

- **Using Climate Models.** Climate models are essential for obtaining climate information and implementing solutions. As indicated by the purple bar in Figure 8, local governments responding to the needs assessment survey are least familiar with using these tools. Some text-entry responses noted issues with choosing the right climate model for their community (Lingelbach, 2020). Additionally, responses acknowledged difficulties in interpreting raw climate data to identify social and economic vulnerabilities (Lingelbach, 2020); for instance, using temperature projections to estimate the health vulnerabilities of their elderly and outdoor worker populations.
- **Climate Solutions.** As discussed in challenge two, many people are unaware of local climate planning options. On the needs assessment survey (2020), not knowing where to start or begin ranked relatively high as a barrier for climate policy implementation, particularly for rural inland areas in counties such as Alachua, Washington, and Madison, and Highlands. Similarly, farmers across the United States are unable to scale up their adaptation actions because they are uncertain of cost-effective and environmentally friendly solutions (Hales et al., 2014). So, among local governments, community businesses, and individuals, there is a need for technical information on best climate management practices and planning under various climate scenarios (Lingelbach, 2020).

Figure 8. The Level of Climate Science Knowledge among Local Governments in Florida

Note. Respondents were asked to estimate their institution's comprehension of key climate concepts from levels of very well to not at all understood. The majority of responses for all concepts frequently occur in the "somewhat" range. Adapted from "Florida Local Government Climate Policy Needs Assessment Survey" by L. Lingelbach, 2020. Copyright 2020 by UF/IFAS Extension and Florida Sea Grant.

What factors contribute to rural gaps in climate knowledge?

(1) Access to Training Resources and Climate Information

To increase technical skills knowledge, rural experts and stakeholders can be trained and educated on using and interpreting climate data for planning purposes. However, sharing this information requires additional time, financial resources, and staff capacity that many rural communities do not have (Hales et al., 2014; Lingelbach, 2020). So, they may not be able to

invest in such resource-intensive educational opportunities. Moreover, climate information is often provided in inopportune and exclusionary formats. Conferences and workshops hosted by climate researchers and policymakers are primarily held in coastal areas or large urban cities, while climate data is accessible through internet services (Grant & Bonveccio, 2019; Hauser & Jadin, 2012). Since small rural communities experience physical isolation and digital disparities, acquiring climate knowledge proves more difficult.

(2) Limited Use of Available Climate Data

Local government officials want more science-based information on climate change in Florida communities so they can implement adaptive management techniques (Lingelbach, 2020). As mentioned in challenge one, despite a plethora of resources, locally specific climate information is often insufficient to meet these needs (Hauser & Jadin, 2012). In particular, climate data and projections are primarily available at global, regional, or statewide scales because of the technical challenges and financial costs of downscaling climate models (Hales et al., 2014; Lal et al., 2011). Large-scale data offers only generalized decision-making guidance and social and economic information, such as probable crop reductions or increased heat-related illnesses across Florida (Hales et al., 2014; Lal et al., 2011). Without more specific local data, rural stakeholders, especially marginalized groups, may struggle to connect observed changes to local activities and conditions as well as find solutions appropriate for their climate situations.

Knowledge is power for both local governments and those in the community. Rural residents are already better prepared to manage environmental issues because of their considerable depth of environmental and natural-resource knowledge and experience. So, if rural understanding of anthropogenic links to climate change, models, and local solutions are improved, community members can be empowered and overcome capacity obstacles to

participate in climate efforts. Although the interactions with and materials from climate specialists complicates obtaining climate knowledge, the rural interest is there and so are the opportunities to learn more (Lingelbach, 2020).

Challenge Four: External Connections and Coordination

One challenge that has been prevalent throughout this research is the connection to and coordination with outside groups. External agents include those from federal and state agencies, nearby communities or counties, nonprofits and businesses, academic institutions, and environmental advocacy organizations. They offer direct and indirect financial, technical, and advisory support to both local governments and community stakeholders pursuing climate action (Hauser & Jadin, 2012). In return, these external groups can address climate impacts at the multiple scales on which they occur and attain their own adaptation and mitigation goals (Hauser & Jadin, 2012). For instance, state and federal agencies work towards emission reduction goals by providing local government training workshops on greenhouse gas inventories as well as business incentives for adopting energy efficiency standards.

External agents already collaborate with Florida's rural communities to address healthcare access, economic development, natural resource industries, and other priorities. As an example, the Florida Rural Health Association promotes rural access to healthcare through a statewide partnership among physicians, hospitals, clinics, and rural governments (Florida Rural Health Association, 2019). Even so, compared to urban communities, rural ones feel more excluded and detached from extraneous climate planning opportunities and materials (Bonnie et al., 2020; Hales et al., 2014; Hauser & Jadin, 2012; Lingelbach, 2020). This research found that the largest rural disconnect is felt from federal agencies, the state government, regional networks, and counties.

- **Federal Agencies.** The federal government offers numerous technical assistance and funding programs for climate resiliency, such as the Department of Homeland Security's Building Resilient Infrastructure and Communities (BRIC) program. However, rural (71%), suburban (61%), and urban (57%) residents alike believe that rural areas receive less federal dollars (Parker et al., 2020). In Florida, this belief is somewhat founded. Particularly, residents in rural Northwest Florida counties, such as Calhoun, are still suffering from Hurricane Michael's damages in 2018 because of the lack of substantial federal or state recovery funds (BGC, 2020). Moreover, rural citizens feel that they are often left out of federal climate policy conversations (Hauser & Jadin, 2012; Pechar Diamond et al., 2020). To illustrate, rural landowners are often not consulted on renewable energy projects constructed on nearby federal lands despite their impact on surrounding private properties (Hauser & Jadin, 2012).
- **State Agencies.** Denoted in the needs assessment survey (2020) and the Barometer Florida project (2020), state leadership and coordination is significantly lacking in rural Florida. Over the years, the state has implemented a few resilience support programs and policies, such as the Community Resilience Initiatives, the Florida Coastal Management Program, Florida Resilient Coastlines Program, and Adaptation Action Areas. Yet, these efforts are primarily aimed at providing resources and opportunities to coastal communities experiencing direct sea level impacts. Moreover, despite recognizing its failures in statewide climate directives, the 2019 annual report by Florida's former chief resilience officer reiterated the primary focus on these areas (Chief Resilience Officer, 2019; Sampson, 2020).
- **Regional Groups.** Many respondents to the needs assessment survey expressed the importance of regional groups to their climate planning efforts. These organized bodies assemble small and large communities across a geographical region to coordinate and

support each other's climate goals. Florida has a few regional alliances including the Southeast Florida Climate Change Compact, the Tampa Bay Resiliency Coalition, and the East Central Florida Regional Resilience Collaborative (Lingelbach et al., 2021). However, in analyzing their membership, there are few rural inland communities involved. Furthermore, large-scale climate networks are non-existent in the Panhandle, North Central, and Southwest areas, where these communities are primarily located.

- **County Government:** Most rural counties in Florida have a few small incorporated municipalities (Office of Policy Planning, 2018). Since county governments have greater resource capacities, these municipalities believe their main responsibility is to be educated and aware of climate change while the county leads efforts (Lingelbach, 2020). In reality, Florida's rural county governments have yet to assume this role (BGC, 2020; Lingelbach, 2020). As a result, small localities are confronted with addressing local challenges without much guidance from the county (Lingelbach, 2020).

What factors contribute to weak interactions between external agents and rural areas?

(1) Physical and Digital Isolation

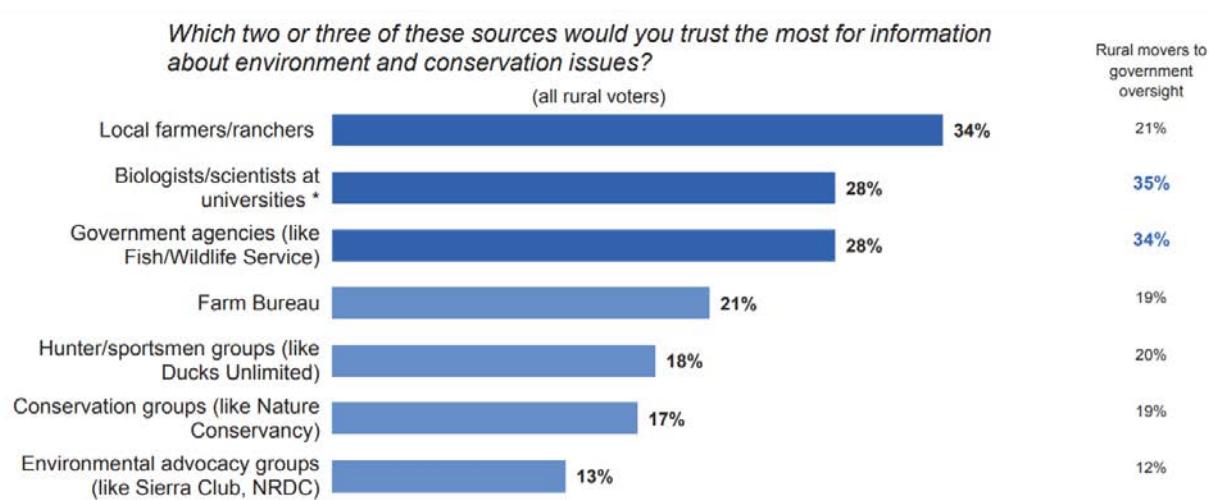
Some external agents, such as federal regulators or university researchers, are hundreds to thousands of miles away from rural areas. Given remote distance and lack of quick transportation to urban centers in North Central, Northwest, and South Central Florida, meeting with outside experts can be challenging (Gutierrez & LeProvost, 2016; Hales et al., 2014). Those living farther away from the county seat have to travel out of their way to attend public meetings held at the county administrative building. Although the COVID-19 pandemic has increased the use of online networking opportunities, rural areas also have poor access to reliable and affordable

communication resources such as high-speed Internet (Gutierrez & LeProvost, 2016; Hales et al., 2014). Thus, external connections can be strained from the characteristic geographical and technological remoteness of rural communities.

(1) Mistrust in Outside Groups

People tend to highly regard others within their immediate social circles (Clayton et al., 2016). In fact, the general American public expresses high confidence in public school principals, medical researchers (i.e. doctors), and religious leaders to act on their behalf (Funk, 2020). Similarly, rural residents across the United States trust local farmers and ranchers the most for environmental information (see Figure 9). On the other hand, they are more wary of external agents such as federal and state elected officials due to rural communities' historical exclusion from policy considerations and conversations (Funk, 2020; Lingelbach, 2020; Pechar Diamond et al., 2020). As shown in Figure 10, small communities of 1,000 people or less do not rely on these groups for climate information.

Rural voters are accepting of some external groups that are integrated into the local social network (Clayton et al., 2016). For instance in Figure 9, they are shown to trust information from some government agencies who are more present and supportive of rural communities such as the US Department of Agriculture, U.S. Fish and Wildlife Service, and U.S. Forest Service (Pechar Diamond et al., 2020). Furthermore, in the first three pie graphs of Figure 10, the Florida League of Cities, Florida Association of Counties, and UF/IFAS Extension appear to be the primary sources of climate information for small Florida communities. Small rural towns and counties are members of the first two groups, and rural residents often use UF/IFAS Extension services to guide decisions pertaining to agriculture, the natural environment, and family resources (Hauser & Jadin, 2012; Lingelbach, 2020).

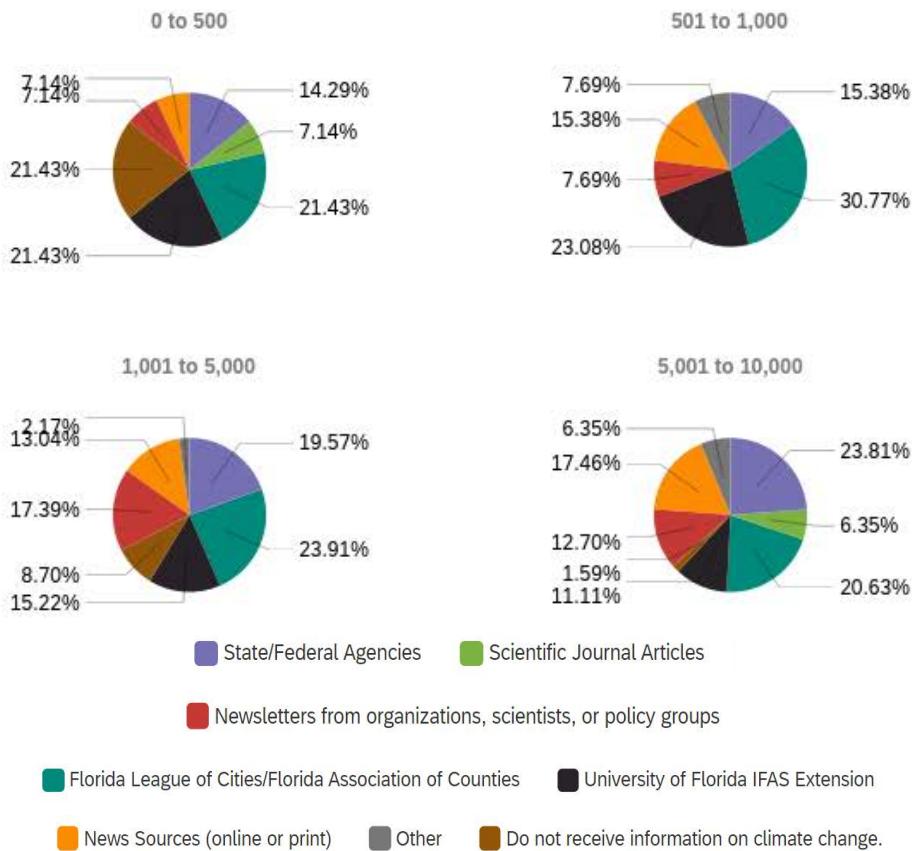
Figure 9. Trusted Sources of Information for Rural Voters in the United States

Note. This bar graph represents the frequency distribution of the groups that rural voters across the United States trust the most for environmental and conservation information. From "Understanding Rural Attitudes Toward the Environment and Conservation in America" (p. 22), by R. Bonnie, E. Pechar Diamond, and E. Rowe, 2020. Nicholas Institute for Environmental Policy Solutions. Copyright 2020 by Nicholas Institute for Environmental Policy Solutions.

(2) Misunderstandings Between the Two Entities

Despite the rural character of stewardship discussed above, rural inhabitants are less-venerated as environmental stewards concerned with a changing climate by outside groups. To enumerate, a study by Duke University revealed that rural voters (63%) are more likely to think that they protect the environment than urban and suburban ones (47%) (Pechar Diamond et al., 2020). Viewing rural residents as unconcerned with climate issues, some external agents may not see the benefits of engaging with such groups or find them to be lost causes. Leaving them out of such conversations induces rural residents to feel wary about climate issues and develop negative perceptions of such groups (Pechar Diamond et al., 2020). Hence, misconceptions from both groups may contribute to their further separation.

Figure 10. Sources of Climate Science and Policy Information in Florida Communities Based on Population



Note. These pie charts represent percentages of municipalities that receive climate information from various sources. Only populations below 10,000 are displayed here since that is what small rural municipalities are considered in this paper. However, some of the small areas in this graph are from coastal areas. Although, these coastal areas do experience similar issues regarding resource capacity as the rural ones. Adapted from “Florida Local Government Climate Policy Needs Assessment Survey” by L. Lingelbach, 2020. Copyright 2020 by UF/IFAS Extension and Florida Sea Grant.

Overall, external groups such as federal and state agencies fail to empower rural communities by not directing climate support towards them. The disunified climate efforts across Florida and within its 67 counties aggravate rural climate vulnerabilities and implementation challenges. In a feedback loop, limited external focus on rural climate impacts contributes to rural residents' disinterests in the topic, further marginalizes low-income areas, and creates additional obstacles for expanding resource capacities and climate planning skills (Barrett, 2013; Grant & Bonveccio, 2019).

IMPLICATIONS OF THE RESULTS

What can be done to overcome challenges to climate action? The following recommendations were designed to lower the barriers identified. By no means is this list exhaustive or applicable to all of the diverse rural communities in Florida. However, it provides a good starting point for various stakeholders—local governments, community members, and external actors—to enhance their climate planning capabilities.

Local Governments

As indicated in a Duke University study, rural residents support climate policy that promotes local decision-making authority (Bonnie et al., 2020). Whether it is a municipality, county, school district, or special taxing district, all forms of local governments are key to implementing climate action. These self-governing entities are responsible for managing their communities alongside physical, economic, and social changes. So, they can implement policies and programs that address local climate impacts and prepare the community for future intensified climate extremes.

Professional Training and Climate Leadership

- Train staff on adaptive management skills and climate planning tools.
- Establish leadership for overseeing climate strategies either within local government (e.g. departments or staff members) or with community leaders via task forces and advisory boards.
- Perform a vulnerability assessment to prioritize climate actions according to the needs of citizens and community assets, quantified at-risk populations, and local resource capacity.
- Integrate climate considerations into existing operations, such as disaster preparedness procedures, comprehensive plans, natural resource management decisions, economic development and social equity initiatives, and other overlapping goals.

It is crucial that governments establish professionally trained climate leadership to identify and implement feasible climate policies. Staff can work to build their knowledge on the issues and ways to minimize impacts through formal training or informal education (Hauser & Jadin, 2012). From there, they can establish climate leadership within their entities based on those who are trained. This leadership can also involve community members who are knowledgeable or concerned about local climate impacts.

Then, to identify resource-efficient options, leaders can perform a vulnerability assessment. These valuations determine climate risks and their anticipated impacts on various community resources, sectors, and populations (Hauser & Jadin, 2012). With this information, solutions that address immediate needs within funding and resource capabilities are prioritized (Hauser & Jadin, 2012). Vulnerability assessments also aid in adaptive management by planning under various climate scenarios (Harvey et al., 2012).

Likewise, local leaders can save resources by incorporating climate considerations into community operations and priorities, such as economic development and social equity issues. In fact, fusing climate models into growth-management planning, climate risks in infrastructure projects and capital budgets, and resilient designs into building codes are common techniques of local climate planning (Lingelbach, 2020). Also, climate adaptation actions are often included in comprehensive plans, local mitigation strategies, and economic development plans (Lingelbach, 2020). For instance, Washington County's new land-use plan calls for climate education in community outreach efforts (BGC, 2020). In relation to prioritizing socially vulnerable populations, community revitalization efforts can preserve historic low-income areas and update infrastructure in marginalized communities for flood and heat resiliency.

Community Learning

- Host inclusive, collaborative community dialogues on local climate impacts and solutions aimed at empowering vulnerable populations.
- Provide climate learning opportunities inside and outside the classroom to K-12 students through the school district.

Since local governments have direct access to local residents, they can offer on-the-ground climate engagement opportunities, such as workshops, focus groups, and digital campaigns (Lingelbach et al., 2021). Activities should be inclusive of disenfranchised populations by reducing barriers (i.e. language, location, time, transportation, childcare, and food) that continually leave them out from policy conversations (Grant & Bonveccio, 2019; Seattle Office of Civil Rights, 2011). Through this community climate education, local governments can increase political and public will as well as reduce climate literacy gaps.

To demonstrate, a climate dialogue between residents and the local entity can offer more insights into the effects of climate on the community. Residents can connect locally observed changes such as intensified summer stormwater flooding to climate shifts, and learn what is meant by climate action planning. Meanwhile, local governments learn from those with firsthand experience of climate impacts (Pechar Diamond et al., 2020). Eventually, as communities understand the salience of climate change in such conversations, they can offer ideas and feedback on climate planning solutions through opportunities such as climate advisory boards.

Additionally, schools and school districts can weave climate education into curriculum and school activities. In interactive lessons on basic climate science, teachers relate the information to the students' personal lives by asking about their own experiences or conversing on recent weather-related events in the community. Similarly, local farmers, or other climate experts, can enlighten students on real-world climate experiences outside the classroom by

showing climate damages on their property or the technology they use to adapt their techniques. Through participation, students begin building their own climate literacy skills.

Local and Regional Coalitions

- Form a local resource alliance with community stakeholders, businesses, and agencies in the existing social networks (e.g. the county and taxing districts) to finance climate solutions, gather local climate data, access additional resources, receive feedback on policy solutions, and coordinate climate actions.
- Strengthen external partnerships with other nearby governments and community-based organizations by creating or joining a rural coalition similar to the South Florida Regional Climate Compact or the Rural Climate Network.

These entities can also build their institutional capacity through internal and external coalitions that provide access to climate data, increase expertise, and offer supplemental human and financial resources. Within the community, numerous stakeholders, like businesses or nonprofits, can be recruited to form public private partnerships for investing in resilient infrastructure or notifying employees or customers of climate related hazards (Lawson et al., 2017). By taking part in sustainability initiatives, these community stakeholders show leadership and provide support to more-vulnerable citizens and low-income areas (Clayton et al., 2016). To help get businesses on board, local governments should recruit businesses through tangible data and engagement opportunities (Lawson et al., 2017). Additionally, local governments can collaborate with the county to implement large-scale strategies.

Similarly, through a regional alliance, governments and community organizations can pool resources, share their climate action experiences, and identify solutions tailored to the region's needs and challenges (Grant & Bonveccio, 2019). If these rural groups were to participate in a regional pact, Florida's Regional Planning Councils are a great avenue because they already exist and climate overlaps with land-use planning (Hauser & Jadin, 2012). This is

the route the East Central Florida Regional Resiliency Collaborative chose. Similar to these regional groups, there are national groups that coordinate small community actions, such as the Rural Climate Network and the Mayor's Climate Protection Agreement.

Community Stakeholders and Organizations

As mentioned in challenge two, sometimes rural local governments lack the capacity to lead climate efforts or prioritize solutions for them. Community-based organizations (e.g. local Rotary clubs, business associations, and churches) and local residents with existing climate knowledge (e.g. high school teachers or retired scientists) can fill technical, financial, and social resource gaps. This is especially true since rural residents prefer to take actions themselves at a business or individual level rather than be regulated by government entities (BGC, 2020; Pechar Diamond et al., 2020). Since community leaders and members are part of these organizations, they share the values of local residents, experience the reality of concerns in the community, and are more trusted by other locals (Clayton et al., 2016; Pechar Diamond et al., 2020).

Community-Led Climate Efforts

- Participate in individual, organizational, community-wide, and large-scale climate action opportunities. Examples of such action include:
 - performing self-vulnerability assessments,
 - serving on advisory boards,
 - attending skill training sessions, and
 - engaging in resiliency planning dialogues.

As noted in this recommendation, community stakeholders can take various types of actions themselves as well as contribute to those implemented by local government. For instance, they can join climate leadership by serving on climate advisory boards (Lingelbach et al., 2021). Through task forces, these residents can be brought into the conversation, allowing local government entities to take pressure off internal staff. Some members can also increase the

climate understanding of local governments with the help of local data experts. Together these groups can take the lead on community climate efforts to compensate for a local government's capacity challenges.

Climate Communication and Activism

- Lead community climate conversations and build local coalitions by capitalizing on existing social connections.
- Advocate through grassroots activism that local, state, and federal governments acknowledge rural climate impacts, use a participatory policy process, and aid in the adoption of local climate policy.

According to climate expert Katherine Hayhoe (2018), an essential part of fighting climate change is talking about it. Community stakeholders can engage themselves and those within their social networks on climate actions. For example, a farming family can teach their children or friends about the importance of climate and weather data in their operations. Furthermore, climate change can be integrated into the discussions of community organizations well-connected to the local social scene, such as faith communities, schools, business associations, and philanthropic groups. For instance, religious leaders can connect environmental stewardship ideals in the Bible to make the case for partaking in climate planning activities. Through continual conversations, local leaders can improve community sentiment and build supportive climate action groups of rural residents. Then, these individuals and groups can advocate for governmental aid and policy solutions that they think are best fit for the community. In other words, they can increase the political will both within and outside their communities.

Financial and Technical Support

- Form public-private partnerships through locally based businesses and business associations.
- Share localized data and climate science information collected from daily observations by farmers and other local experts.

- Use organizational connections to expand access to outside groups and devise large-scale partnerships.

As mentioned in the local government recommendations, community organizations can provide additional support to government entities through public-private partnerships. These stakeholders can also increase community climate knowledge through those citizens and professionals who collect, interpret, or use climate science information. For instance, those who have lived on the land for a long time, such as agriculturalists, can contribute valuable data of the historical changes the community underwent through accounts and older land use maps (Pechar Diamond et al., 2020). Similarly, these local experts can contribute to global climate knowledge. To illustrate, farmers and other field workers can share daily observations of their use of various adaptation technologies to the relevant researchers. Such interactions can reduce misconceptions of those outside of the community. Hence, the climate information base can be enhanced for both the local and global community.

Likewise, community organizations can use their network connections to further expand the access to outside groups. To clarify, Rotary clubs are connected to the international organization; farmers are a part of the county- and state-wide Florida Farm Bureau; and, businesses are connected to local or regional chambers of commerce. These associations can link the community to additional funding sources and technical support systems. They can also create a regional alliance with leaders from across these groups to coordinate efforts and build the capacity of their communities.

External Actors

As established, external actors contribute significantly to the rural gap in climate action. While it is important that they work with these communities to overcome capacity and climate

literacy challenges, it is also key that they do not overstep boundaries (Hauser & Jadin, 2012).

Instead, they should promote community-based climate management by empowering local residents and remaining in an advisory role. This is particularly recommended since rural areas tend to mistrust some of these entities.

Rural Climate Resources

- Cater climate information to the vulnerabilities, values, and wants of rural inland communities.
- Provide similar or expand existing incentive, grant, and assistance programs, training opportunities, and consulting services offered to coastal and urban communities.
- Develop additional climate financing options for local entities and individual stakeholders through environmental finance groups, banks, insurance companies, or real-estate markets.

Current climate information and services can be improved by tailoring and offering it to rural stakeholders. Based on employee feedback from the needs assessment survey (2020), Florida's local governments want instructions for climate planning, data on climate risks relevant to their communities, ideas of practical adaptation and mitigation strategies, options for climate financing, and tools for decision-making and analyzing data. Rural climate materials, including training, information, data, and interpretation consults, should reflect these demands along with other rural values and priorities. In fact, more climate research and communication should relate the means in which various climate risks may affect current infrastructure and recovery systems, agricultural and ecotourism industries, and rural health (Lingelbach, 2020). By contextualizing climate data, external agents can develop its applicability to rural areas and possibly increase rural residents' interests in climate action.

Moreover, expanding the current general resources provided to other communities creates opportunities for rural areas to enhance their investment capacity. Certainly, public and private

actors alike can expand their climate funding options. For instance, the state of Florida can broaden the designation of adaptation action areas to those with inland flooding risks so that rural areas can also receive technical and financial support for addressing infrastructure and other impacts. Likewise, banks and other financial institutions can offer green loan programs to residents for adaptation or mitigation strategies or advise customers on climate risks associated with investment opportunities (Cleveland et al., 2019). Community development financial institutions, particularly, can be more useful to rural localities than typical private banks because they prioritize community members, like small businesses or individual homeowners (Cleveland et al., 2019).

Sharing Resources

- Administer information and services in affordable and accessible formats.
- Aggregate tools, case studies, template ordinances and plans, and best management practices specific to rural stakeholders into a single online database.
- Distribute information in partnership with or through trusted sources.

It is not enough to simply provide rural resources. External agents should affirm they are reaching their intended audience. Offering free or low-cost services in digital, in-person, and mixed forms allows for more inclusive outreach (Hauser & Jadin, 2012). Also, climate databases or other information hotspots, like Gulf TREE's climate resilience tool and the U.S. Climate Resilience Toolkit, minimize staff and resource capacity issues when obtaining climate knowledge. So, groups such as extension or state agencies can create a one-stop shop toolkit specific to Florida or rural areas (Lingelbach, 2020). Lastly, rural stakeholders are more receptive to information from trusted and commonly used sources of information, such as UF/IFAS Extension, the Florida League of Cities or Florida Association of Counties, local newspapers, and email distribution lists (Lingelbach, 2020). For instance, with a relatively high

level of trust in medical scientists among Americans, medical doctors can engage their patients and the community about public health effects from extreme heat.

Community Interactions

- Communicate clearly with messages that connect to local values and focus on solutions.
- Cultivate relationships with community champions and experts to build support for action, better understand local climate impacts, and strengthen trust networks.

To build trust and promote use of climate products, external agents should work on the culture of interaction with rural stakeholders. Since external agents collaborate with a wide range of groups within rural communities, they should ascertain messages are formed and easily understood by their target audience (Lingelbach, 2020). Moreover, the communication of climate science and impacts is more encouraging if it is linked to local climate examples and values, weather and agriculture, and primarily covers climate solutions that also address other priority issues, like clean water (Bonnie et al., 2020; Hauser & Jadin, 2012; Pechar Diamond et al., 2020). Such techniques have been found to increase rural perceptions of risks and their abilities to handle those (Bonnie et al., 2020).

Since rural communities are concerned about being told what to do by outside groups, agents should establish their supportive listener role by collaborating with and learning from community members. Through a built relationship, local individuals may endorse the trustworthiness of third-party groups and empower others residents or officials to act; while, agents improve messaging and data for the needs of the community (Hauser & Jadin, 2012; Pechar Diamond et al., 2020). To illustrate, during the Florida Institute for Built Environment Resilience project in historically marginalized areas of North Port St. Joe, valuable community insights were gained through interviews and workshops, and community champions were trained

on developing resilience strategies (UF College of Design, Planning, and Construction, 2021).

Approaching rural communities with clearer communication and transparent intentions can build community climate sentiment and trust in outside groups.

CONCLUSION

Although rural interior areas of Florida are experiencing impacts from a changing climate, they are lagging behind urban and suburban counterparts in addressing the issue. Without planning, these communities, their citizens, and their vital economic and environmental assets become more vulnerable to future intensified impacts. While investigating obstacles that contribute to the lack of climate action, this research identified the influence of community sentiment, investment capacity, gaps in climate literacy, and external connections and coordination. Due to their size, geographical location, and socioeconomic situations, they experience resource and technical barriers that hinder their knowledge on local adaptation and mitigation actions. Although there is concern for climate related impacts, a rural narrative of climate as nonurgent or unlikely has decreased political and public will to invest in their climate planning capabilities. These issues are exacerbated by scarce inclusion and engagement efforts of other major players including the state and federal government, business investors, non-profits, and climate scientists.

Due to the data used in this research, there are some limitations to these findings.

1. The phrasing of questions from all the surveys as well as the inherent government bias and lack of random sampling from the needs assessment survey may have influenced the results and their interpretations.
2. The needs assessment survey only measured the perceptions of government employees and not community stakeholders.
3. The difference between rural and peripheral areas was not well addressed when reviewing the subset of the survey.
4. Rural communities in Florida were understood through primarily national characterizations of rural values and socioeconomic demographics.

5. There are national and statewide gaps in the type of and access to information on rural climate action.

Thus, there may be other challenges or possible factors contributing to them that are not detected in this paper. These limitations can be avoided in future research through a few mechanisms. First, data gathering can specifically target rural Florida and involve unincorporated areas rather than all incorporated municipalities and counties as the needs assessment survey did. Second, more inclusive surveys via phone, online, and in person could be used to engage community stakeholders, especially those in low-income areas since they are often more socially vulnerable. Getting these community perspectives can provide more detailed and holistic information on the community sentiment, climate technical skills, and climate action challenges. Third, other social and economic rural climate impacts could be further researched, especially those related to agriculture, mental and physical health concerns, and climate displacement patterns. Such information could increase understanding of how climate is already impacting communities or relates to social and economic priorities within them. Fourth, to better understand the role of external climate-focused agencies and non-governmental organizations, the reasons for their scant rural engagement should be further investigated.

Nevertheless, while starting to fill the research gap on the rural Florida climate story, this paper has identified important ideas for igniting widespread local climate action (see Implications of the Results). These suggestions rely on rural citizens to implement climate strategies according to the needs and values of their own communities. Many residents are already resilient and strong in the face of environmental, economic, and social issues, and they are interested in learning about actions they can take now. To support these local actors, governments and other external agents must actively minimize barriers and form a dialogue among all groups to lead to science-based, feasible local solutions. Doing so can empower

citizens and their communities to greater awareness, leadership, and ability to manage the climate shifts occurring now, while planning for resilient future generations of Floridians.

References

Barrett S. (2013). Local level climate justice? Adaptation finance and vulnerability reduction.

Global Environmental Change, 23, 1819–1829.

<https://doi.org/10.1016/j.gloenvcha.2013.07.015>

Bausback, E. (2020). Heat policies in Florida may overlook most vulnerable. *WUFT News*.

<https://projects.wuft.org/humanhazard/heat-policies-in-florida-may-overlook-most-vulnerable/>

Bonnie, R., Pechar Diamond, & E., Rowe, E. (2020). *Understanding rural attitudes toward the environment and conservation in America* (NI Report 20-03). Nicholas Institute for Environmental Policy Solutions.

<https://nicholasinstitute.duke.edu/sites/default/files/publications/understanding-rural-attitudes-toward-environment-conservation-america.pdf>

Carter, L., Terando, A., Dows, K., Hiers, K., Kunkel, K.E., Lascurain, A., Marcy, D., Osland, M., & Schramm, P. (2018). Southeast. In D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, & B.C. Stewart (Eds.), *Impacts, risks, and adaptation in the United States: Fourth national climate assessment, volume II* (pp. 743-808). U.S.

Global Change Research Program. <https://doi.org/10.7930/NCA4.2018.CH19>

Chief Resilience Officer. (2019). *2019 Annual Report*. Executive Office of the Governor.

<https://assets.documentcloud.org/documents/6867224/Florida-Chief-Resilience-Officer-2019-Annual.pdf>

City of Live Oak. (2019). *Economic Incentive Program*.

https://www.cityofliveoak.org/economic_development

Clayton, S., Silka, L., Trott, C., Chapman, D., & Mancoli, S. (2016). *Building resilient communities in the face of climate change: A resource for local communities*. The Society for the Psychological Study of Social Issues.

<https://www.spssi.org/index.cfm?fuseaction=document.viewdocument&ID=3F28EB86AE4CA3BB2EE025BE0093BF04C3C86089AFFADC9117681192CC17EABCA6952AE18DBE281F122D1C5A3A1CBA2>

Cleveland, J., Crowe, J., DeBacker, L., Munk, T., & Plastrik, P. (2019, October 17). Hunting for money: U.S. cities need a system for financing climate resilience and adaptation. *Community Development Innovation Review*. <https://www.frbsf.org/community-development/publications/community-development-investment-review/2019/october/hunting-for-money-u-s-cities-need-a-system-for-financing-climate-resilience-and-adaptation/>

Dzaugis, M.P., Reidmiller D.R., Avery, C.W., Crimmins, A., Dahlman, L., Easterling, D.R., Gaal, R., Greenhalgh, E., Herring, D., Kunkel, K.E. Kunkel, Lindsey, R., Maycock, T.K., Molar, R., Stewart, B.C., & Vose, R.S. (2018). Frequently Asked Questions. In D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, & B.C. Stewart (Eds.), *Impacts, risks, and adaptation in the United States: Fourth national climate assessment, volume II* (pp. 1444-1515). U.S. Global Change Research Program.

<https://doi.org/10.7930/NCA4.2018.AP5>

Environmental Protection Agency. (2016). What climate change means for Florida.

<https://www.epa.gov/sites/production/files/2016-08/documents/climate-change-fl.pdf>

Florida Department of Environmental Protection. (2020). *FRCP Resilience Grants*.

<https://floridadep.gov/rpc/florida-resilient-coastlines-program/content/frcp-resilience-grants>

Florida Rural Health Association. (2019). *History, Mission, Goals*.
<https://www.floridaruralhealth.org/history-mission-goals>

Florida TaxWatch Research Institute. (2019). *How Florida counties compare*.
<https://floridataxwatch.org/Research/Full-Library/ArtMID/34407/ArticleID/18800/2019-How-Florida-Counties-Compare>

Funk, C. (2020, February 12). Key findings about Americans' confidence in science and their views on scientists' role in society. *Pew Research Center*. <https://www.pewresearch.org/fact-tank/2020/02/12/key-findings-about-americans-confidence-in-science-and-their-views-on-scientists-role-in-society/>

Grant, S & Bonveccio, A. (2019). Coastal justice: Climate change and social resilience in Florida [White paper]. University of Florida Levin College of Law. <https://www.law.ufl.edu/law/wp-content/uploads/Sekita-Grant-Coastal-Justice-White-Paper.pdf>

Gutierrez, K. S., & LePrevost, C. E. (2016). Climate justice in rural Southeastern United States: A review of climate change impacts and effects on human health. *International journal of environmental research and public health*, 13(2), 189.
<https://doi.org/10.3390/ijerph13020189>

Hales, D., Hohenstein, W., Bidwell, M., Landry, C., McGranahan, D., Molnar, J., Morton, L. W., Vasquez, M., & Jadin, J. (2014). Rural communities. In J. M. Melillo, T.C. Richmond, & G. W. Yohe (Eds.), *Climate change impacts in the United States: The third national climate assessment* (pp. 339 – 349). U.S. Global Change Research Program.
<https://doi.org/10.7930/J01Z429C>

Harvey, R.G., Brandt, L.A., & Mazzotti, F.J. (2012). *Climate change adaptation: New perspectives for natural resource management and conservation*. UF/IFAS Extension.
<https://edis.ifas.ufl.edu/pdffiles/UW/UW36300.pdf>

Hauer, M.E. (2017). Migration induced by sea-level rise could reshape the US population landscape. *Nature Climate Change*, 7, 321-325. <https://doi.org/10.1038/nclimate3271>

Hauser, R. & Jadin, J. (2012). *Rural communities workshop technical report to the 2013 national climate assessment*. U.S. Global Change Research Program.

https://downloads.globalchange.gov/nca/technical_inputs/rural-communities-workshop-technical-input.pdf

Hayhoe, K. (2018). *The most important thing you can do to fight climate change: talk about it* [Video]. TED Conferences.

https://www.ted.com/talks/katharine_hayhoe_the_most_important_thing_you_can_do_to_fight_climate_change_talk_about_it?language=en

Her, Y.G., Boote, K.J., Migliaccio, K.W., Fraisse, C., Letson, D., Mbuya, O., Anahdhi, A., Chi, H., Ngatia, L., & Asseng, S. (2017). Climate change impacts and adaptation in Florida's agriculture. In Chassinet, E.P., Obeysekera, T.B., Misra, V., & Jones, J.W. (Eds.), *Florida's Climate: Changes, Variations, & Impacts*. Florida Climate Institute.

<https://floridaclimatelinstitute.org/docs/climatebook/Ch08-Her.pdf>

Kennedy, B. (2020, June 29). Most Americans say climate change affects their local community, including 70% living near coast. *Pew Research Center*. <https://www.pewresearch.org/fact-tank/2020/06/29/most-americans-say-climate-change-impacts-their-community-but-effects-vary-by-region-2/>

Lal, P., Alavalapati, J., & Mercer, D.E. (2011). Socioeconomic impacts of climate change on rural communities in the United States. In United States Department of Agriculture (Ed.), *Effects of climate change on natural resources and communities: A compendium of briefing papers* (Report PNW-GTR-837).

https://www.srs.fs.usda.gov/pubs/ja/2011/ja_2011_lal_001.pdf

Lawson, A., Maher, K., Peace, J. (2017). Guide to public-private collaboration on city climate resilience planning. *Center for Climate and Energy Solutions*.

<https://www.c2es.org/site/assets/uploads/2017/05/guide-public-private-collaboration-city-climate-resilience-planning.pdf>

Lingelbach, L.A. (2020). *Florida local government climate policy needs assessment survey* [Unpublished raw data]. UF/IFAS Extension & Florida Sea Grant.

Lingelbach, L., Betancourt, A, Abeels, H, & Smyth, A. (2021). *Handbook for municipal action on climate change*. Unpublished manuscript.

Marlon, J., Howe, P., Mildenberger, M., Leiserowitz, A., & Wang, X. (2020). *Yale Climate Opinion Maps 2020*. Yale Program on Climate Change Communication.

<https://climatecommunication.yale.edu/visualizations-data/ycom-us/>

Nathan, A. (2019, July 15). Climate is the newest gentrifying force, and its effects are already reshaping cities. *Harvard University The Graduate School of Arts and Sciences*.

<https://sitn.hms.harvard.edu/flash/2019/climate-newest-gentrifying-force-effects-already-reshaping-cities/>

National Oceanic and Atmospheric Administration. (2014). *What is climate literacy?*. NOAA Climate.gov. <https://www.climate.gov/teaching/essential-principles-climate-literacy/what-climate-science-literacy>

Office of Policy Planning. (2018). *Florida's rural areas*. Florida Department of Transportation.

https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/policy/ruralsupport/florida-39-s-rural-areas_final-appb.pdf?sfvrsn=ac5f9ea2_2

Parker, K., Horowitz, J.M., Brown, A., Fry, R., Cohn, D., & Igielnik, R. (2018, May 22). How people in urban, suburban, and rural communities see each other - and say others see them.

Pew Research Center. <https://www.pewresearch.org/social-trends/2018/05/22/how-people-in-urban-suburban-and-rural-communities-see-each-other-and-say-others-see-them/>

Pechar Diamond, E., Bonnie, R., & Rowe, E. (2020). *Rural attitudes on climate change: Lessons from national and Midwest polling and focus groups* (NI Report 20-06). Nicholas Institute for Environmental Policy Solutions.

https://nicholasinstitute.duke.edu/sites/default/files/publications/Rural-Attitudes-on-Climate-Change-Midwest_1.pdf

Ramos, A., & Renne, J.L. (2020, August 10). Hurricanes and COVID-19 in Florida: Are counties prepared to protect hurricane-vulnerable populations? *Union of Concerned Scientists.*

<https://blog.ucsusa.org/science-blogger/hurricanes-and-covid-19-in-florida-are-counties-prepared-to-protect-hurricane-vulnerable-populations>

Runkle, J., Kunkel, K., Champion, S., Frankson, R., Stewart, B., & Sweet, W. (2017). Florida state climate summary. *NOAA Technical Report NESDIS 149-FL*. NOAA National Centers for Environmental Information. <https://statesummaries.ncics.org/chapter/fl/>

Sampson, Z.T. (2020, April 23). Florida's climate change efforts 'disjointed', former state resilience officer found. *Tampa Bay Times*.

<https://www.tampabay.com/news/environment/2020/04/22/floridas-climate-change-efforts-disjointed-former-state-resilience-officer-found/>

Seattle Office for Civil Rights (2012). Inclusive outreach and public engagement guide.

https://southeastfloridaclimatecompact.org/wp-content/uploads/2020/03/RCAP_InclusiveOutreachandPublicEngagement.pdf.

Sikder, A. & Mozumder, P. (2019). Risk perceptions and adaptation to climate change and sea-level rise: Insights from general public opinion survey in Florida. *Journal of Water Resources Planning and Management*, 146(3). [https://doi.org/10.1061/\(ASCE\)WR.1943-5452.0001156](https://doi.org/10.1061/(ASCE)WR.1943-5452.0001156)

Vainio, A. & Paloniemi, R. (2013). Does belief matter in climate change action? *Public Understanding of Science*, 22(4), 382-395. <https://doi.org/10.1177/0963662511410268>

UF Bob Graham Center for Public Service. (2020). *Barometer Florida*.

<https://bobgrahamcenter.ufl.edu/barometer-florida/>

UF College of Design, Construction, & Planning. (2021). *Port St. Joe research projects and academic courses*. <https://dcp.ufl.edu/frc/psjprojects/>

USDA Economic Research Service. (2021). *State fact sheets: Florida*.

<https://data.ers.usda.gov/reports.aspx?StateFIPS=12&StateName=Florida&ID=17854>