AN ANALYSIS OF COMMUNITY RESILIENCE INDICATORS IN THE SOUTH TEXAS COASTAL BEND REGION

A Thesis

by

YVONNE MARIE SHEASBY

BS, Texas A&M University-Corpus Christi, 2020

Submitted in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

in

ENVIRONMENTAL SCIENCE

Texas A&M University-Corpus Christi
Corpus Christi, Texas

December 2022

December 2022

AN ANALYSIS OF COMMUNITY RESILIENCE INDICATORS IN THE SOUTH TEXAS COASTAL BEND REGION

A Thesis

by

YVONNE MARIE SHEASBY

This thesis meets the standards for scope and quality of
Texas A&M University-Corpus Christi and is hereby approved.

David Yoskowitz, PhD
Chair

Kateryna Wowk Porter, PhD
Co- Committee Chair

Daniel Jorgensen, PhD
Committee Member

December 2022

ABSTRACT

Community Resilience is the collective ability to diversify the strengths in a community and establish safeguards to better mitigate impacts from disasters. The application of community resilience is different in every community because of their unique characteristics and what hazards they face. This is one of the reasons why measuring community resilience at the local level is vital. Since Hurricane Harvey hit the Texas mid-coast in 2017, the Coastal Bend region and all the local governments within have shifted their focus increasingly toward community resilience and currently need assistance with resilience capacity-building. To identify their needs and what capacity exists already, communities in the Coastal Bend region should conduct an analysis of community resilience indicators and the assessment methodologies they are included in. Though there are several community resilience assessment methodologies worldwide, only 8 out of 73 indices met the selection criteria established during this study and were included in the analysis. It is difficult to know which assessment methodology is best to use for different types of communities and situations. Many communities, especially in rural and underserved areas, lack the resources to conduct and implement resilience measurements. The purpose of this study is to develop a new methodology to determine which community resilience assessment tool(s) are best to use at the local level by conducting a case study analysis in three counties in the South Texas Coastal Bend region, which include Nueces, Refugio, and San Patricio. After distributing two surveys and conducting two focus group sessions, the results were used to help evaluate if community resilience measurement at the local level can be adapted to take into account all shocks and stressors.

ACKNOWLEDGEMENTS

Words cannot express my gratitude to my faculty advisor and chair of my committee, Dr. David Yoskowitz, for his invaluable patience and feedback. This endeavor would not have been possible without him or Dr. Kateryna Wowk, my supervisor and co-committee chair, who has provided me with the resources to continue my education and has continually supported me throughout this process. I also could not have undertaken this journey without my thesis committee, who generously provided knowledge and expertise. Additionally, I would like to express my deepest appreciation to my colleagues and higher-ups at Harte Research Institute (HRI) for their generous support and continual guidance.

I am also grateful to my classmates and cohort members, especially my office mates, for their editing help, afternoon feedback sessions, late-night email conversations, and moral support. Thanks should also go to the staff and students of the Texas A&M University-Corpus Christi (TAMU-CC) Department of Physical and Environmental Sciences and College of Graduate Studies, who impacted and inspired me. Many thanks to my peer and committee member, Dr. Daniel Jorgensen, at the TAMU-CC Department of Social Sciences for his assistance and guidance in creating the two surveys distributed during this research study.

Lastly, I would be remiss in not mentioning my family, especially my parents, and my significant other. Their belief in me has kept my spirits and motivation high during the course of this project. I would also like to thank the people in the communities of the South Texas Coastal Bend region for inspiring my research and encouraging me to take this next step in my future career.

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

CHAPTER I: INTRODUCTION

Purpose and Significance of the Study

Climate change refers to "any change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards" (Lineman et al., 2015). The effects of climate change are caused predominately by the burning of fossil fuels, which releases harmful greenhouse gases into the atmosphere. One of the effects of climate change is the increase in extreme and more frequent weather events. The increase in extreme weather events is "caused by warmer sea surface temperatures and changes in the ocean environment" (Mendelsohn, 2012). With more heat energy available from this effect of climate change, there is a higher possibility for tropical cyclones to develop (Berardelli, 2019). According to recent studies, tropical cyclone intensities worldwide will foreseeably increase on average suggesting a larger increase in the destructive potential per storm (NOAA Geophysical Fluid Dynamics Laboratory, 2021). Concurrently, there is a "growing concentration of people and properties in coastal areas, increasing coastal vulnerability and resulting in greater losses from extreme weather events" (Mendelsohn, 2012). Addressing these pressing threats calls for an approach combining the knowledge of preparation for disasters with actions that can be taken to strengthen communities' adaptive capacity. That is where the importance of building community resilience comes into play. Community resilience is an important concept in disaster mitigation because it involves improving, adapting, and "building on an interconnected network of systems that directly impact human society at a grassroots community level" (Fitzpatrick, 2016). With the effects of climate change increasing storm frequency and intensity, it is vital that we understand and build on community resilience at the local level and beyond.

Community resilience is defined as "a community's ability to adapt and thrive under changing conditions." (Gundlach, 2016). In the face of different disasters or stressors, a resilient community can withstand damage and recover quickly. Since Hurricane Harvey made landfall along the Texas mid-coast in August of 2017, the Coastal Bend region and all the local governments within have been shifting their focus more towards community resilience and need assistance with resilience capacity-building. This disaster and the magnitude of the resulting damage highlighted the need for communities of all types and their government leaders to enhance their ability to withstand and recover from such shocks. To identify the populations' needs and what adaptive capacity already exists at the local level, communities in the Coastal Bend region should analyze community resilience indicators and the community resilience assessment methodologies that use these indicators.

Research Objectives

Measuring community resilience is vital. The concept can be used to "improve response and recovery planning; define and prioritize mitigation efforts; and make choices related to policy, insurance pricing, and other investments" (Gundlach, 2016). There are many frameworks and tools available to communities that offer methods to measure community resilience. Despite this array of available resources, many communities, especially in rural and underserved areas, lack the resources to implement resilience measurement. Another issue local governments face is the difficulty of identifying which community resilience assessment tool to use at the local level, especially when considering the different risk hazards and a community's unique characteristics. There is no one-size-fits-all approach to measuring and practicing resilience. No single measurement tool "fits the resilience measurement needs of all communities" (The National Academies, 2019). Although community-focused indicators are considered in all assessment

methodologies, assessment methodologies mostly rely on county and U.S. census tract data because of the lacking availability of community-level data. Assessing community resilience at the community level and individual level is important to avoid gaps in coverage. If there were a more organized and specialized approach to community resilience indicator analysis at the municipal level, communities would benefit by understanding which tool or tools are best for them to use for community resilience assessment. Ideally, the assessment tool(s) a community would use should help them identify their needs, the resources they have available at their disposal, and what funding opportunities they need to prioritize to meet their identified needs. This research addresses this issue by accomplishing the following objectives:

- Review community resilience assessment methodologies, the indicators used in these assessments, and the strengths and gaps of each, particularly for use in small towns and rural areas
- Identify community resilience-related data, existing capacity, local level needs, and community factors in the three counties selected to take a survey (Refugio, San Patricio, and Nueces Counties)
- Review the results of the literature review, two surveys, and three focus group sessions.
- Develop and offer a methodology using the results to help communities determine the most appropriate community resilience assessment tool at the local level since every community and situation is unique and different from one another.

The study is significant to the field of natural disaster mitigation and adds to the overall body of knowledge by analyzing different community resilience assessment methodologies and their indicators to produce a method for identifying the right assessment methodology for a specific community. The research hypothesized an all-hazards, multi-community and multi-

cultural approach to measuring community resilience is possible to develop. By conducting a comparative analysis of assessment methodologies and their indicators, this phase of the study showed that while some commonalities exist, there are also considerable differences between these tools. Local governments, especially in rural and underserved areas, generally lack the capacity to analyze different methodologies and assess their community's resilience at the same time. Although there has been increased recognition of the importance of developing methods and instruments for its assessment, not only is it difficult to measure community resilience at the local level because of the lacking resources; it is also difficult to measure because there is rarely a community resilience assessment model that considers a community's unique factors and the risk hazards a community faces. The results of this study are meaningful to the field by adding to the overall knowledge of how community resilience assessment at the local level can be adapted to take into account all shocks and stressors.

An outcome of this research was to assess and identify which community resilience assessment methodologies are more useful and meaningful to the communities within the three Coastal Bend counties based on their unique factors and needs, while also offering a methodology to the broader community on how to select the best-fitting resilience assessment tool at the local level. An analysis of community resilience assessment methodologies, based on a community's characteristics, is needed to improve and strengthen disaster risk mitigation efforts in the Coastal Bend region. Every county in the Coastal Bend region is different, and each community and circumstance are unique. The purpose of this research is to discover a new methodology to determine which community resilience assessment tool is best to use at the local level, based on different risk hazards and a community's unique factors. This research attempts to answer the following questions:

1. Would community resilience be improved if a methodology to determine the most appropriate resilience assessment tool was available at the local level?
2. Though the spatial resolution of most community resilience assessment methodologies is at the county level, can this approach be adapted to rural, small, and underserved communities even though the data primarily used in assessment methodologies is at the county or census tract level?
3. With this research, is it possible to take into account all shocks and stressors (acute, chronic, anthropogenic, and natural) when measuring community resilience at the local level?

CHAPTER II: LITERATURE REVIEW

Study Area

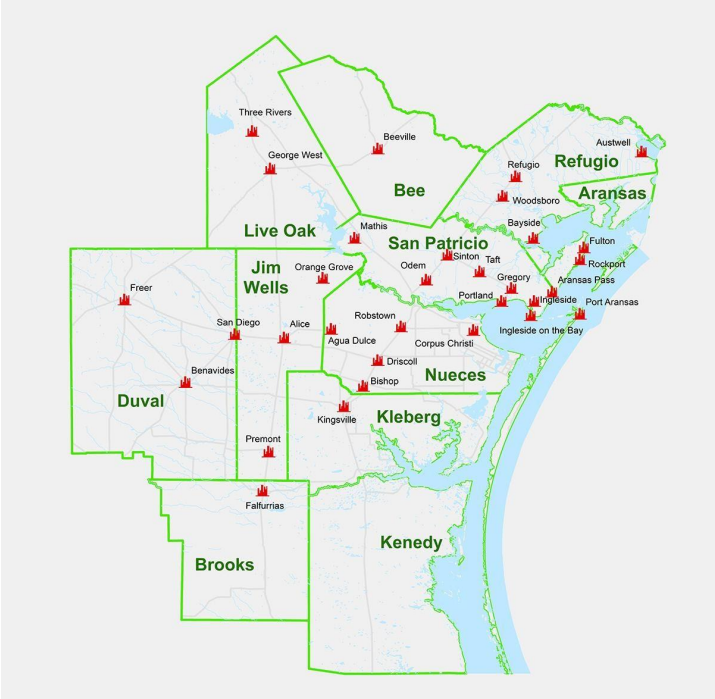

Figure 1: Map of the South Texas Coastal Bend Region

The research study focuses on three counties in the South Texas Coastal Bend region for case study analysis. *Figure 1* shows the 11 counties in the South Texas Coastal Bend region for reference. Since there are a total of 11 counties in the South Texas Coastal Bend region, several community characteristics and socioeconomic data were considered when creating and applying selection criteria to see which three counties were best to analyze. The selection criteria for choosing the counties identified to focus on during the case study analysis included: (1) availability of data, (2) community type and characteristics in that county, (3) man-made or natural disasters threats faced, (4) existing capacity, and (5) topographic location in the region. After establishing the selection criteria for the study area, I researched data associated with these standards for the counties of the Coastal Bend region.

Based on the selection criteria above, I conducted a case study analysis on the following three counties and their communities: Refugio, San Patricio, and Nueces. These counties were chosen to be a part of the case study analysis because of the selection criteria data collected and analyzed. This data information is further discussed in the Study Area section below. One of the research goals mentioned is to see if this approach can be adapted to each of the three main types of communities which is urban, suburban, and rural. The counties selected include at least one or more of the three community types. These three counties also meet the criteria above with the difference in socioeconomic data, such as unemployment and poverty rates, health insurance, educational attainment, and home ownership. The increasing coastal vulnerability of these three counties also meets the selection criteria above. The communities selected within these three identified counties to hold the focus group sessions are Corpus Christi, Portland, and Refugio. County information, along with relevant socioeconomic data and collected data during the selection criteria process, is mentioned below for reference:

Refugio County Description

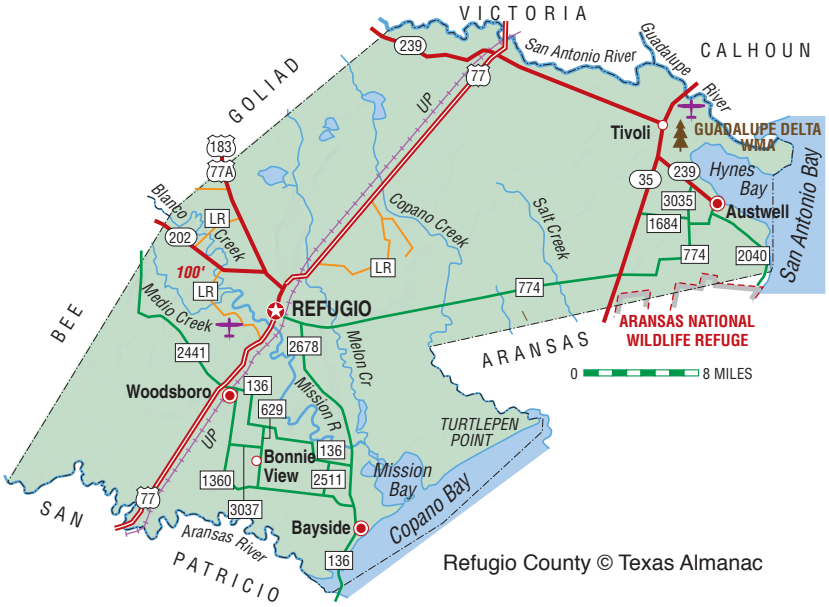

Figure 2: Detailed map of Refugio County, TX

Figure 2 shows a detailed map of Refugio County, one of the three Coastal Bend counties selected for research in this study. Refugio County is located on the lower Gulf Coast in the South Texas Coastal Bend region. It is bordered

by San Patricio County to the south, Bee and Goliad counties to the west, Victoria and Calhoun counties to the north, and Aransas County to the east. The town of Refugio, which is the county's seat of government and largest urban center, is 35 miles north of Corpus Christi, the largest city in the South Texas Coastal Bend region. As of the 2019 U.S. census, Refugio County has "a population of 6,948 people with a -5.9 percent population change" (U.S. Census Bureau Population Estimates Program, 2019). With most of the communities having a population under 5,000 people, most of Refugio County can be identified as a rural area. According to the 2019 U.S. Census, individuals without health insurance are "about 17.4 percent of the population, and individuals below the poverty line [are] about 18 percent of the population" (U.S. Census American Community Survey, 2019). The U.S. national poverty rate is "10.5 percent of the population" (U.S. Census Bureau, 2020), and the national uninsured rate is "about 9.2 percent of the population" (Grubbs et al., 2020). In comparison, "20.8 percent of the Texas state population lived below the poverty line in 2019" (U.S. Census American Community Survey, 2019). The Texas state uninsured rate is "at about 18.4 percent of the population" (Grubbs et al., 2020). When comparing the national and state averages with the Refugio County average, it is shown that the county uninsured rate is higher than the national average and a little less than the state average. The county poverty rate is also less than the state average and greater than the national average. More socioeconomic data from the U.S. Census tract is provided below:

U.S. Census Bureau Statistics (2019)	
Population (2019 est.)	6,948
Percent Population Change (2010 base)	-5.9%
Median Age	43.3
Median Property Value (2015-2019)	$85,600

Owner-Occupied Housing (2015-2019)	72.8%
Median Gross Rent (2015-2019)	$644
Median Household Income (2015-2019)	$50,076
Pop. in Civilian Labor Force (2014-2018)	52.6%
Employment Percent Change (2018-2019)	2.3%
Persons in poverty	18%
Persons without Health Insurance	17.4%
Households with Internet Subscription (2014-2018)	69.9%

Table 1: 2019 U.S. Census Statistical Data of Refugio County, TX

While conducting a comparative analysis of community resilience indicators (shown in the *Indicator Comparison and Analysis* section), the availability of this data for each of the three counties and their communities was researched and included in *Tables 4-11*. The data at the county level was available for most of the identified indicators in each assessment methodology, except for a few of the community-focused indicators such as hospital capacity, public school capacity, presence of mobile homes, and connection to civic and social organizations. The availability of this data at the local level differs significantly for small communities and unincorporated municipalities with most core indicator data inaccessible and/or unavailable. The lack of data available at the local level presents an issue to Refugio County because all their communities and unincorporated municipalities have a population under 5,000 individuals. The procurement of data that requires public input is hard to acquire in these small communities because community outreach and engagement are often difficult for the local government to achieve with little to no online presence.

According to Refugio County's 2022 Multi-Hazard Mitigation Plan, their county is "at risk from the following natural disaster hazards that have occurred and/or are likely to occur: floods, hurricanes/tropical storms, wildfire, tornadoes, drought, extreme heat, hailstorms, winter weather, severe winds, lightning, expansive soils, and coastal erosion" (*Refugio County Multi-Hazard Mitigation Plan 2022,* 2022). Based on Refugio County's topographic location, coastal hazards present more of a threat than other natural disaster events. Certain man-made disaster risks, such as marine and inland oil spills, are likely to occur within the county limits. The identification of present natural and man-made disaster risks is important to know because disaster focus is one of the factors to consider when choosing the best community resilience assessment tool at the local level.

San Patricio County Description

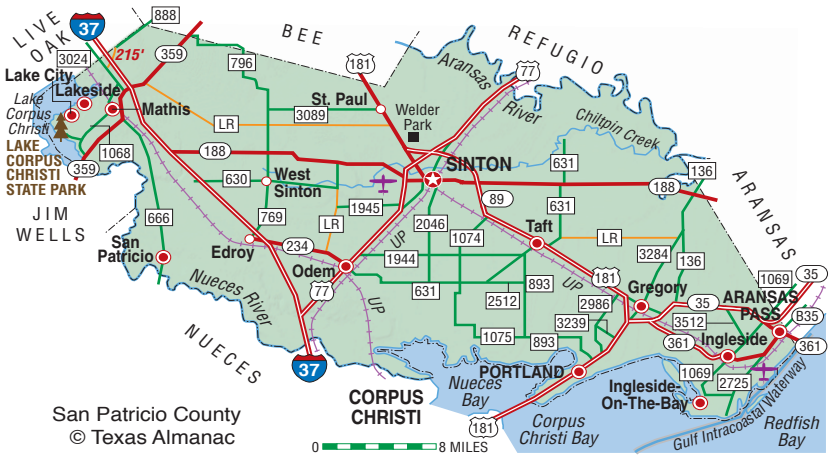

Figure 3: Detailed map of San Patricio County

San Patricio County is located on the lower Gulf Coast in the South Texas Coastal Bend. *Figure 3* shows a detailed map of San Patricio County. It is bordered by Bee County to the north, Refugio County to the northeast, Aransas County to the east, Nueces County to the southeast, and Jim Wells and Live Oak counties to the west. The town of Sinton, the county's seat of government, is 16 miles north of Corpus Christi, the largest city in the Coastal Bend. The largest city in San Patricio County is Portland, "with a population of 17,268 people" (U.S. Census Bureau Population

Estimates Program, 2019). As of the 2019 U.S. Census, San Patricio County has "a population of 66,730 people, with a positive three percent population change" (U.S. Census Bureau Population Estimates Program, 2019). San Patricio County is made up primarily of suburban and rural areas that have populations of less than 10,000 people. According to the 2019 U.S. Census, individuals without health insurance are "17.7 percent of the county population, and individuals below the poverty line are 14.4 percent of the population" (U.S. Census American Community Survey, 2019). More socioeconomic data from the U.S. Census tract is provided below:

U.S. Census Bureau Statistics (2019)	
Population (2019 est.)	66,730
Percent Population Change (2010 base)	3%
Median Age	35.5
Median Property Value (2015-2019)	$122,100
Owner-Occupied Housing (2015-2019)	68.3%
Median Gross Rent (2015-2019)	$975
Median Household Income (2015-2019)	$56,556
Pop. in Civilian Labor Force (2015-2019)	59.0%
Employment Percent Change (2018-2019)	-0.9%
Persons in poverty	14.4%
Persons without Health Insurance	17.7%
Households with Internet Subscription (2015-2019)	72.2%

Table 2: 2019 U.S. Census Statistical Data of San Patricio County, TX

The availability of community resilience indicator data identified during the study is available at the local level for major communities and the county. The only indicator data found to be inaccessible to the public, even at the county level, includes these identified core indicators shared among methodologies: hospital capacity, hotel/motel capacity, public school capacity, and affiliation with religion. The following natural disaster events present a risk to the county population in the order of likelihood to occur: Flood, Hurricane/Tropical Storm, Extreme Heat, Thunderstorm Winds, Drought, Lightning, Expansive Soils, Hail, Wildfire, Tornado, Dam Failure, and Winter Storm. Due to the topographic location, San Patricio County is more vulnerable to coastal hazards due to its proximity to water bodies and low elevation. The presence of oil and natural gas companies also presents other man-made disaster risks including oil spills and natural gas leaks.

Nueces County Description

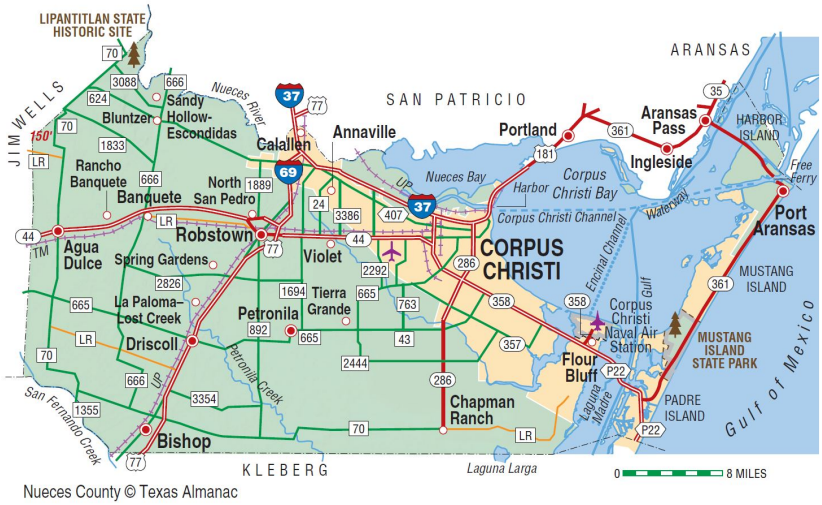

Figure 4: Detailed Map of Nueces County, TX

Nueces County is located on the lower Gulf Coast in the South Texas Coastal Bend region. *Figure 4* shows a detailed map of Nueces County. It is bordered by San Patricio and Aransas counties to the east, Jim Wells County to the northwest, and Kleberg County to the south. The city of Corpus Christi is the county's seat of government and the largest city in the Coastal Bend region. As of the 2019 U.S. Census, Nueces County has "a population of 362,294 people with a positive 6.5 percent population

change" (U.S. Census Bureau Population Estimates Program, 2019). Of that county population, "326,586 people live in the city of Corpus Christi" (U.S. Census Bureau Population Estimates Program, 2019). Nueces County is part of the Corpus Christi metropolitan statistical area. It is also made up of suburban and rural areas, which makes it an appropriate study site to include in the case study analysis. The reason why Nueces County was selected for the research is based on proving this study's approach applies to all three main types of communities, including urban areas. According to the 2019 U.S. Census, individuals without health insurance are "20.3 percent of the population, and individuals below the poverty line are 16.5 percent of the population" (U.S. Census American Community Survey, 2019). More socioeconomic data from the U.S. Census tract is provided below:

U.S. Census Bureau Statistics (2019)	
Population (2019 est.)	362,294
Percent Population Change (2010 base)	6.5%
Median Age	35.5
Median Property Value (2015-2019)	$138,700
Owner-Occupied Housing (2015-2019)	58%
Median Gross Rent (2014-2018)	$1,017
Median Household Income (2015-2019)	$55,919
Pop. in Civilian Labor Force (2015-2019)	62%
Employment Percent Change (2018-2019)	3.1%
Persons in poverty	16.5%
Persons without Health Insurance	20.3%

Households with Internet Subscription (2015-2019)	81.3%

Table 3: 2019 U.S. Census Statistical Data of Nueces County, TX

The availability of community resilience indicator data is reliable and consistent for Nueces County and its major cities. There are only a few core indicators, such as Public School Capacity and Affiliation with Religion, that do not have data available currently for the county and/or small communities. This is mainly due to these community-focused indicators not being available at the local and sub-county levels. Most of the community-focused indicator data used in these methodologies are not available for smaller communities and unincorporated municipalities in Nueces County. According to the local capability assessment survey Nueces County incorporated into its recent Hazard Mitigation Action Plan, the county government showed a strong capacity to undertake and implement mitigation actions through existing planning, regulatory, administrative, technical, and fiscal capabilities. However, Nueces County does have several small communities and unincorporated municipalities. These smaller communities do not have the same capacity as Nueces County does currently to undertake and implement mitigation actions.

According to the Nueces County 2017 Multi-Jurisdictional Hazard Mitigation Action Plan, the county faces the "following natural disaster risks [in order of likelihood to occur]: Hurricanes/Tropical Storms, Flood, Drought, Windstorms, Extreme Heat, Lightning, Coastal Erosion, Tornado, Hailstorm, Expansive Soils, Dam Failure, Land Subsidence, Wildfire, and Severe Winter Storms" (*Nueces County Texas Multi-Jurisdictional Hazard Mitigation Action Plan,* 2017). Due to the county's topographic location, coastal hazards, such as flooding and hurricanes/tropical storms, present more of a pressing threat to the population.

Methodology

This research was separated into three stages: literature review, comparative analysis of assessment methodologies and their indicators, and case study analysis. A literature review of past and present research was used to identify different assessment methodologies, their indicators, and the important strengths and gaps of each. The literature analysis was conducted by first identifying the sources used in FEMA's 2020 Community Resilience Indicator Analysis and the 2022 update. Next, I analyzed these sources and identified the articles they used as references. Keywords (such as community resilience, measurement, and disaster mitigation) were used to identify more articles in Google Scholar and the TAMU-CC Library database. **Using these sources,** I identified eight community resilience assessment methodologies and their indicators.

The next step was to conduct a comparative analysis of the selected assessment methodologies, and their indicators, to determine which methodologies are best-fitting and adaptable to different types of communities. A comparative analysis helps establish relationships between experimental variables and phenomena by identifying similarities and differences. By isolating these aspects, it is possible "to develop a conceptual model of the possible relations between the various entities" (Given, 2008). The indicators used in these methodologies were separated into two categories: community-focused and population-focused. The analysis of indicators ascertained which assessment methodology used more community-focused indicators, which would not be found in census tract data, than population-focused indicators. The results identified which assessment methodologies focused more on measuring community resilience at the local level than at the county level.

The third stage of the study was to perform a case study analysis, which includes conducting two surveys and two focus group sessions. A survey research method was utilized because this method allows researchers "to obtain information [and analyze] the characteristics of a large sample of individuals of interest relatively quickly" (Ponto, 2015). Although the research used most of FEMA's selection criteria, it also considered the survey results because the selection criteria must apply to every type of community. Two surveys were created and distributed in the three selected Coastal Bend counties. The General Public Survey was distributed to the residents of those communities. The Public Officials and Stakeholders Survey was distributed to the public officials and government/organization employees in the study area. The two surveys acted as information seekers to identify and extract what capacity exists, the data they have currently on community resilience indicators, community characteristics, and the needs present.

Using Qualtrics, the Public Official and Stakeholders Survey was emailed to 134 key community leaders and stakeholders in the study area, such as emergency managers, floodplain managers, county judges, mayors, city managers, environmental health specialists, and more. This survey was also sent to a few contacts with regional government associations and non-profit, community organizations. The contact information was collected through online research and contacting respective colleagues. Researching accessible contact information online was necessary to identify if the public can contact these key community leaders and other stakeholders. If their email address was inaccessible online, that contact was deleted and not included as a potential participant. Email addresses collected were inserted into an excel spreadsheet for easier access, which made it easier to send to these individuals using the Qualtrics email tool. The survey was open for four weeks. The twenty-three questions included

different question types such as slider scales and matrix tables. I included question behavior logic into the survey, such as skipping to the end of the survey if the participant does not give consent or if the individual is not familiar with the concept of community resilience. The consent form link was attached to the "I consent, begin the study" button in the introduction of the survey for the participants. If a participant did not submit a consent form, their survey responses were deemed invalid and deleted prior to data analysis of the results.

The General Public Survey used a combined approach, creating a Facebook AD to reach certain age groups online and holding a diverse focus group in two selected communities. This was necessary to ensure the targeted audience was reached. With the Facebook AD Center, I only included the zip codes of Nueces, Refugio, and San Patricio counties in the Audience selection section. Other inclusion criteria, such as occupations or an age limit for specific user interaction, were also included in this section. An age limit was set for ages 18-65+. Other reasons why a Facebook advertisement was accurate to use is because the cost was inexpensive, and it could reach a larger number of people. The Ad included details about the study and focus groups, participation in the survey, and a link to the survey questionnaire. If a potential participant had a question, they could either: comment directly on the Facebook AD, direct message the Facebook page used to distribute the Facebook AD, or email me for further assistance. With permission from the page owner, the General Public Survey was distributed through the Regional Resilience Partnership's Facebook page. They were identified as a community organization that shares one or more of the same goals as the research study, which is to assess and improve community resilience in the South Texas Coastal Bend region.

An incentive of receiving a $5 Starbucks gift card was provided for individuals participating in the General Public Survey. Participation qualifications included meeting the

participant inclusion criteria highlighted in the consent form and submitting a consent to participate form. The survey and consent form requires an email address because that is how I distributed the gift card compensation to the participants. Once the survey ended after two weeks, I acquired a certain amount of gift cards per number of participants by paying for these in bulk and distributing them via Starbucks' Corporate Gift Card Sales website to the participant's given email address. The participants received their gift cards within two business weeks of the survey distribution end date.

Conducting focus groups was useful because I gathered more information in a shorter period and gained some insight into the community being analyzed. Focus groups help researchers learn more about a community's opinions and needs, which is like needs assessment surveys. Originally, there were three communities selected to hold a focus group in, for a total of three focus groups. Only two focus group sessions (Corpus Christi and Portland) were possible to conduct. Participants from the focus group sessions were primarily volunteers from the general public survey. The identification of and establishment of communication with a key leader in each community was a second option I used for recruitment. If that individual had access or knew someone who had access, a request to distribute a post on one or more of their social media pages was submitted. If given permission, a final post draft was sent over for review and distribution with a graphic made in Canva. This alternative method was utilized and/or attempted during the recruitment phase for the Portland and Refugio focus group sessions. Attempts made to recruit participants in Refugio failed due to a lack of social media/online presence with the local government and therefore an absence of community engagement. Using this alternative method of recruitment did succeed in gaining participants for the Portland focus

group. A consent form was required because these individuals did not go through an informed consent process before participation.

The two focus groups were conducted on the TAMU-CC Zoom platform. A total of 12 questions were asked, which took around an hour of participation. The participants were given the questions in advance and had the opportunity to answer them in the focus group session. I asked questions about their experiences and opinions about different resilience indicators while facilitating the discussion. An incentive to participate was provided, which included a random raffle drawing for one $50 Target Gift Card during both focus groups. Excel was used to perform the random raffle drawings after the focus group was conducted. Two columns were added to a table, the first with email addresses. To the left of this data, I created a ‘Random Numbers’ column and used the formula "=RAND()" for the first data cell in the next column. Then, I dragged the formula down the column to create random numbers for each participant. The next step included selecting the titles of the columns (first row) and using the "Sort and Filter" button on the home bar. I added a filter and sorted the Random Number column from smallest to largest, which randomly shuffled the participants' list. Using this method, I decided to pick the first random number at the top of the list. The gift cards were sent individually to the two random raffle drawing winners, one business week after the focus group was concluded, via email through the Target website using the participant’s email address provided.

CHAPTER III: RESULTS

Literature Review

The eight community resilience assessment methodologies that were reviewed and analyzed include: 1) Australian National Disaster Resilience Index (ANDRI), 2) Baseline Resilience Indicators for Communities (BRIC), 3) Community Disaster Resilience Index (CDRI), 4) Community Resilience Index (CRI), 5) Disaster Resilience of Place (DROP), 6) Resilient Capacity Index (RCI), 7) Social Vulnerability Index (SVI), and 8) The Composite Resilience Index (TCRI). These methodologies were selected to analyze because all eight methodologies were selected by FEMA in their analysis "based on commonly used indicators, general risk focus, availability of data, applicability to different communities and pre-disaster conditions" (Federal Emergency Management Agency, 2020). The following text defines each of the eight methodologies, providing information to highlight the strengths and weaknesses of each compared to one another. The metrics used to select the eight community resilience assessment methodologies for analysis in the study are summarized in *Table 4: Methodology Metric Summary Table*.

6 out of 8 methodologies selected were more applicable to measure community resilience at the local level. These methodologies include the Baseline Resilience Indicators for Communities Index, Community Disaster Resilience Index, Community Resilience Index, Disaster Resilience of Place, Social Vulnerability Index, and Composite Resilience Index. Out of those methodologies, I identified the most comprehensive methodologies among them, which includes the Baseline Resilience Indicators for Communities Index, Disaster Resilience of Place Index, and Community Disaster Resilience Index. This is based mostly on the number of core

indicators shared, general availability of data, applicability to different communities and situations, intended audience, and their outputs.

The Australian National Disaster Resilience Index (ANDRI) is primarily focused on community resilience to natural hazards. This index is based "on two sets of capacities: coping capacities and adaptive capacities" (Federal Emergency Management Agency, 2020). Coping capacity is defined by people or organizations that can use available resources and abilities to face disaster risk. It includes six key factors used in ANDRI to "measure overall disaster resilience, which is: social character, economic capital, emergency services, planning, and the built environment, community capital, and information access" (Parsons et al., 2017). Adaptive capacity "measures the arrangements and processes that are in place in the community to enable adjustment through learning, adaptation, and transformation" (Parsons et al., 2017). It includes two key factors used in ANDRI, which are social and community engagement and governance and leadership. According to experts, the index sets a new precedence for measuring future changes in resilience to natural hazards and promoting resilience-building initiatives. The tool also proposes five disaster resilience profiles in Australia, each is "based on collections of communities that all fit a similar profile of resilience strengths and constraints" (Parsons et al., 2017). This helps communities research and apply resilience-building initiatives by identifying areas like where individuals live, looking at what those communities alike have done to build resilience, and assessing whether a similar approach will work for their community. The area of focus for their approach is at the national and local levels of Australia. Since multiple indicators used in the index are solely based on the communities in Australia, most of the indicators used also apply to U.S. communities and counties if that indicator's data is available to the public and up to date.

The Baseline Resilience Indicators for Communities (BRIC) views community resilience as "a complex process of interactions between various social systems, each with its own form and function but working in tandem to provide for the betterment of the whole community" (Federal Emergency Management Agency, 2020). BRIC uses a common set of variables to measure the "inherent resilience of counties in the United States according to six different capitals, which are: social, economic, housing and infrastructure, institutional, community, and environmental" (Cutter et al., 2014). It specifically uses 49 variables within these six categories, or capitals, of community resilience to provide an assessment at the local level. The index uses a capital, multi-hazard approach in providing an overall baseline assessment for monitoring existing attributes of resilience to natural hazards. Used to monitor existing factors of resilience to natural hazards, BRIC can be used to "compare areas to one another, determine the specific drivers of the resilience of counties, and monitor improvements in resilience over time" (Cutter et al., 2014). This evidence-based research can influence public policy focused on disaster risk by "guiding policymakers on where investments in resilience-building strategies might make a difference in the improvement of scores given" (Cutter et al., 2014). The tool's targeted audience includes local authorities at the county level. The BRIC Index utilizes "a pre-disaster focus on their approach, meaning it considers pre-disaster conditions of a community or county depending on the unit of analysis" (Federal Emergency Management Agency, 2022). Out of the other methodologies, BRIC uses in its assessment 18 of the 20 core indicators identified in the Indicator Analysis and Comparison phase of the research study.

The Community Disaster Resilience Index (CDRI) defines a community as an ecological network of social systems. This index tool is based on "community attributes that represent four different capital domains: social, economic, physical, and human" (Peacock, 2010). Each

attribute impacts one or more of the four disaster management phases, which are mitigation, preparedness, response, and recovery. It is calculated by "averaging the attributes within each capital domain to acquire the CDR social capital, CDR economic capital, CDR physical capital, and CR human capital indices" (Peacock, 2010). The CDRI will be "created by averaging these four capital indices" (Peacock, 2010). This resulting index represents one community's capital resilience capacity, or the community disaster resilience index (CDRI). It portrays the average capital resources the community possesses for addressing disaster management actions across all disaster management phases. This tool was developed with the practitioners of disaster management and mitigation as the target audience. Coastal communities and counties are the intended unit of analysis in the CDRI. The index utilizes "a multi-hazard, pre-disaster approach to its analysis of community resilience indicators" (Federal Emergency Management Agency, 2022).

The Community Resilience Index (CRI) focuses on "four sets of networked resources, or capacities (Economic Development, Social Capital, Information and Communication, and Community Competence), that define and shape the process of community resilience" (Federal Emergency Management, 2020). Community resilience is a term for "a community's ability to recover from severe stress caused by natural and man-made disaster events" (Sherrieb et al., 2010). These capacities the index focuses on are "not strategies for emergency preparedness, but [they] are a part of the social and economic fabric of the community" (Sherrieb et al., 2010). The index's unit of analysis is at the county level. CRI2 also takes into consideration "pre-disaster conditions of a community and the possible impacts from vulnerability to multiple hazards" (Federal Emergency Management Agency, 2022) while assessing its resilience.

The Disaster Resilience of Place (DROP) in their approach defines resilience as "a set of capacities that can be fostered through interventions and policies" (Federal Emergency Management Agency, 2020), which will help build and enhance community resilience. This methodology measures baseline characteristics of communities that foster resilience. It becomes possible to "monitor changes in resilience over time in particular places and to compare one place to another" (Cutter et al., 2010) by first establishing baseline conditions. The DROP Index does "not have a specific risk focus applied to its methodology, but it considers pre-disaster conditions of the community during analysis" (Federal Emergency Management Agency, 2022). Behind the BRIC Index, DROP has the second most core indicators included in its original resilience indicator analysis.

The Resilient Capacity Index (RCI) assesses a region's resilience by its resiliency capacity, which is the "qualities to cope with future challenges and respond effectively to future stress" (Federal Emergency Management Agency, 2020). This index tool measures "the resilience capacity, with metropolitan areas in mind, to natural disasters and economic shocks" (Winderl, 2014). It is computed as "the average value of different attributes representing three categories: regional economic, socio-demographic, and community connectivity" (Winderl, 2014). With the present limited focus on data analysis, the applicability of this methodology is limited to other community types, such as small, underserved, and/or rural communities.

The Social Vulnerability Index (SVI) makes social vulnerability the primary focus of their approach by analyzing socioeconomic and demographic factors that affect the resilience of communities. County-level socioeconomic and demographic data is used in this index with the purpose of "measuring social vulnerability to environmental hazards in the United States" (Flanagan et al., 2011). Using a factor analytic approach, the index "uses these factors to

compute a summary, or overall score, which is different for each county" (Agency for Toxic Substances and Disease Registry, 2021). The difference in scores highlights the interactive nature of social vulnerability; "some components increase vulnerability [to hazards], while other [components] moderate the effects" (Flanagan et al., 2011).

The final assessment methodology that will be analyzed is The Composite Resilience Index (TCRI). TCRI combines and analyzes "four resilience environments (social, built, natural, and economic) to present a holistic overview of a community's resilience level" (Perfrement & Lloyd, 2015). The unit of analysis for this methodology is at the community level. However, when The Composite Resilience Index was created, "communities in Australia were the methodology's area of focus" (Perfrement & Lloyd, 2015). The applicability of TCRI to other communities is not limited for the variables used in its data analysis is universal, meaning it is also relevant to communities in the United States. This index has "a general risk focus towards natural hazards in its approach, and it considers pre-disaster conditions in its analysis of community resilience" (Federal Emergency Management Agency, 2020).

Methodology Metric Summary Table

CR Assessment Methodology	Number of Core Indicators Shared with Other Methodologies	Unit of Data Analysis	General Availability of This Data	General Risk Focus	Pre or Post Disaster Focus	Applicability
Australian National Disaster Resilience Index (ANDRI)	13	National and Local	Yes	All-hazards	Pre	Limited - possible to apply to US cities with open data resources
Baseline Resilience Indicators for	18	County	Yes	Multiple Hazards	Pre	Yes

Communities (BRIC)						
Community Disaster Resilience Index (CDRI)	14	Coastal	Yes	Multiple Hazards	Pre	Yes - Coastal Communities are the area of focus
Community Resilience Index (CRI2)	9	County	Yes	Multiple Hazards	Pre	Yes
Disaster Resilience of Place (DROP)	16	County	Yes	None	Pre	Yes
Resilient Capacity Index (RCI)	8	Metropolitan Statistical Area	Yes	Multiple Hazards	Pre	Limited - cities are the area of focus in their approach
Social Vulnerability Index (SVI)	10	County	Yes - only socioeconomic and demographic data are used in this index	Multiple Hazards	Pre	Yes - Social Vulnerability is the primary focus of their approach
The Composite Resilience Index (TCRI)	9	Community	Yes - the area of focus is Australia, however.	Natural Hazards	Pre	Yes - for US cities with available open data sources

Table 4: Methodology Metric Summary Table

Indicator Analysis and Comparison

The attached data tables above show the core, or commonly used, indicators in each of the eight assessment methodologies analyzed in the study. These core indicators were identified by "cataloging all indicators in each assessment methodology and determining which met the inclusion criteria and were found in three or more of the eight methodologies" (Federal Emergency Management Agency, 2022). This process, introduced by FEMA's 2020 Community Resilience Indicator Analysis methodology and conducted further during this study, determined which indicators were commonly used among the eight methodologies and the availability of indicator data. The use of one indicator in three or more methodologies indicates "areas where

researchers have agreed on an indicator's importance to community resilience" (Federal Emergency Management Agency, 2022). The commonly used indicators were then separated into two groups: population-focused and community-focused. Population-focused indicators are measures of "attributes that influence an individual's ability to cope with disasters (i.e., age, income, and employment)" (Federal Emergency Management Agency, 2022). Community-focused indicators are measures of "qualities inherent to the local community environment that enhance or detract from the community's ability to prepare for, respond to, or recover from a disaster (i.e., hotels, hospitals, and mobile homes)" (Federal Emergency Management Agency, 2022). Although multiple methodologies grouped indicators into subindexes, the subindexes used and the composition of the subindexes was inconsistent. Therefore, I did not examine the subindexes in this case study analysis and instead analyzed the individual indicators. During the case study analysis portion of the research study, I was focused more on the community-focused indicators identified since those are the measures less accessible and retrievable in small, rural, and/or underserved communities. Population-focused indicators are more accessible and retrievable data, but some small and rural communities still have trouble measuring a few of these attributes. This may be due to less available funding, and thus, a lower resilience capacity in these communities.

The population-focused indicators identified in this study included: educational attainment, unemployment rate, disability, English language proficiency, home ownership, mobility, age, household income, income inequality, health insurance, and single-parent households. Educational attainment, or lack of a High School diploma, is defined as "the percentage of the population over age 25 without a high school diploma, including GED" (Federal Emergency Management Agency, 2022). This indicator is used in seven out of the eight

assessment methodologies used in this study, except for The Composite Resilience Index (TCRI). Education systems have certain features that make them uniquely placed for building up individual, community, and systemic resilience. It contributes to resilience by "strengthening social capital; improving community knowledge of risks and hazards; boosting women's empowerment and gender equality; strengthening human capital; and building internal dispositions to adapt" (Shah, 2019). With higher levels of education, an individual is more likely to have better health and an improved ability to communicate and comprehend information. The practical and bureaucratic obstacles to "assist in coping with and recovering from a disaster is much more difficult to navigate for individuals with lower levels of education" (Flanagan et al., 2011). Educational attainment is also an input of a community's economic resilience because "it is a characteristic of a strong labor force and supports an individual's ability to access resources [during a crisis] (Peacock, 2010). Compared to the national average The next indicator, the unemployment rate, also contributes to a healthy community economy, and therefore, supports community resilience.

The unemployment rate is defined as "the percentage of the labor force [that is] unemployed" (Federal Emergency Management Agency, 2022). This indicator is used in seven out of the eight selected community resilience methodologies, except for the Resilient Capacity Index. Employment is a critical measure used in community resilience assessments because it "provides residents with financial resources that contribute to their livelihoods" (Peacock, 2010). Unemployed individuals do not have access to employee benefits such as income and health insurance in the event of injury or death. Counties with higher levels of unemployment are more likely to have "fewer community resources to support residents' needs and a population that is both less prepared for a disaster and less able to cope with the [resulting damage]" (Perfrement &

Lloyd, 2015). Disability is another population-focused indicator used in community resilience assessment. The disability rate is measured as "the percentage of the population with a disability" (Federal Emergency Management Agency, 2022). Disabled individuals "tend to be more vulnerable to physical, social, and economic challenges" (Cutter et al., 2014) caused by natural and man-made disaster events. Having functional, mobility, or access needs can make "responding to disaster events difficult for individuals with disabilities, including adapting to extreme circumstances and dealing with the resulting increased stress" (Parsons et al., 2017). These individuals are "disproportionately affected in disaster and emergency situations due to inaccessible evacuation, response (shelters, food distribution, etc.), and recovery efforts" (Flanagan et al., 2011). Current research reveals that individuals with disabilities are "more likely to be left behind during a disaster event" (Flanagan et al., 2011). This is due to a lack of preparation and planning, such as inaccessible facilities, services, and transportation systems in a community or county. This specific indicator is not used in the Community Disaster Resilience Index (CDRI) or the Community Resilience Index (CRI).

Limited English Language Proficiency is defined as "the percentage of limited English-speaking households" (Federal Emergency Management Agency, 2020) in a community or county. In the United States and other English-speaking countries, proficiency in English supports a community's resilience by fostering an improved ability to communicate between individuals. This allows individuals to have "better access to community resources through effective communication interactions in the event of a natural or man-made disaster" (Cutter et al., 2014). Communities with fewer English-speaking residents "may indicate lower levels of resilience" (Cutter et al., 2010). In the event of a disaster, accurate translations of advisories may be scarce in these communities where the first language is neither English nor Spanish.

Homeownership is another population-focused indicator of community resilience, which measures the "percentage of housing units that are owner-occupied" (Federal Emergency Management Agency, 2022). This indicator is "often included as a metric of a community's economic strength and thus is [vital in assessing community resilience]" (Cutter et al., 2014). Homeownership "reflects an individual's level of place attachment to their communities" (Peacock, 2010), which means these individuals are less likely to move away after a natural or man-made disaster event. If a community has lower levels of homeownership, it "indicates an unsteady economy and a population with a less long-term commitment to the community" (Parsons et al., 2017). This could obstruct both individual and community mitigation actions for disaster preparedness as well as recovery efforts.

Mobility, or lack of a vehicle, measures the "percentage of occupied housing units with no vehicles available" (Federal Emergency Management Agency, 2022). Mobility is a critical indicator of a community's current resilience to natural and man-made disaster events because it affects all types of communities differently. Communities with higher levels of mobility, which is a lack of access to a vehicle, indicate "a lower level of resilience to a disaster event" (Cutter et al., 2014). In rural communities, having a vehicle is vital for residents because most of the time, that is their only accessible form of transportation to evacuate the area. Lack of access to a vehicle can be particularly problematic in "terms of evacuation in urban areas where automobile ownership is at a lower level" (Flanagan et al., 2011). This is especially true among inner city poor populations. This indicator is used among most of the eight selected community resilience methodologies, except for the Community Resilience Index and Resilient Capacity Index. Individuals aged 65 and older is another metric used in community resilience assessment. Several methodologies indicate the "percentage of elderly adults in the community's population

could affect resilience" (Parsons et al, 2017). Individuals over the age of 65 tend to be" less mobile and find it more difficult to prepare for disasters and adapt to extreme circumstances" (Perfrement & Lloyd, 2015). This metric is similar to the indicator, Disability rate, because individuals who are elderly or have disabilities are both disproportionately affected by disaster events.

Median household income is another population-focused indicator relevant to community resilience. This indicator is commonly used among five out of the eight selected community resilience methodologies, except for the Baseline Resilience Indicators for Communities (BRIC), Disaster Resilience of Place (DROP), and Resilient Capacity Index. There is a strong correlation present between an individual's financial resources and their resilience to disaster events. Low-income households are at greater risk during a disaster event because they "tend to live in lower-quality housing situated in more vulnerable areas, are less likely to be prepared for a disaster, and have fewer resources to support recovery efforts" (Peacock, 2010). This indicator may also "reflect a community's economic resilience and resources available to support recovery efforts" (Perfrement & Lloyd, 2015). Income inequality is a population-focused indicator relevant to community resilience. A major factor in a community's resilience to disaster events is the economic environment. When income inequality is present in a community, earnings tend to be "distributed in a [certain] way that does not support broader community goals" (Cutter et al., 2014). If there is a skewed distribution of economic resources present in a community, it "may negatively affect the cohesiveness of the residents' response to a disaster" (Winderl, 2014). Income inequality is used in half of the eight selected community resilience methodologies. The methodologies that do not contain this indicator in their measurement of community resilience

include Australian National Disaster Resilience Index (ANDRI), Community Resilience Index (CRI), Social Vulnerability Index (SVI), and The Composite Resilience Index (TCRI).

Health is a critical component of a community's well-being. Lack of health insurance is a population-focused indicator used in four out of the eight selected methodologies used in this study. This metric is the "percentage of the population without health insurance" (Federal Emergency Management Agency, 2022). Research has shown an" unhealthy population has more difficulty accessing community support or engaging in the process of building disaster resilience" (Peacock, 2010). If a community has more individuals with health insurance, it will tend to have "higher measures of physical and mental health" (Cutter et al., 2014), which speaks to an individual's capability to effectively respond to and recover from a disaster event. Health insurance coverage is an important indication of a community's resilience. Communities with fewer individuals covered by health insurance "indicate a lower level of resilience than other communities with a higher percentage of individuals with health insurance coverage" (Cutter et al., 2010). Single-parent households are the last identified population-focused indicator used in community resilience assessment. This metric is the "percentage of single-parent households in a community or county" (Federal Emergency Management Agency, 2022). Research has determined that single-parent households are more vulnerable to disaster events. These households "tend to have a lower socioeconomic status, or median household income, and fewer sources of social support than two-parent family households" (Sherrieb et al., 2010). Their increased vulnerability to disaster events is because "all daily responsibilities fall [onto] one parent, making recovery more difficult [and slower to achieve]" (Flanagan et al., 2011). This specific indicator is used in only three out of the eight community resilience methodologies

analyzed in this study. These methodologies include the Australian Natural Disaster Resilience Index (ANDRI), Community Resilience Index (CRI), and Social Vulnerability Index (SVI).

The community-focused indicators identified in this study include Connection to Civic and Social Organizations, Hospital Capacity, Medical Professional Capacity, Affiliation with a Religion, Presence of Mobile Homes, Public School Capacity, Population Change, Hotel/Motel Capacity, and Rental Property Capacity. The indicator, Connection to Civic and Social Organizations, is defined as "the number of civic and social organizations per 10,000 people" (Federal Emergency Management Agency, 2022). This measure indicates a community's "level of engagement by examining the current level of civic infrastructure through which residents support their communities" (Cutter et al., 2014). Residents who participate in local civic and social organizations "can [rely] on them for [support in return] and provide mutually beneficial cooperation during a [disaster event]" (Sherrieb et al., 2010). The availability of social networks in a community can be "[crucial] during response and recovery efforts to quickly mobilize resources and disseminate information" (Peacock, 2010). This measure is the most used community-focused indicator in six out of the eight community resilience methodologies identified in this study. Hospital capacity is defined as "the number of hospitals per 10,000 people" (Federal Emergency Management Agency, 2020). It is used in five out of eight community resilience methodologies utilized in this study, excluding the Community Resilience Index, Resilient Capacity Index, and Social Vulnerability Index. This metric represents "essential community infrastructure, both because it represents the capacity of their healthcare system to support residents' overall health and to provide emergency medical care" (Federal Emergency Management Agency, 2020). A lack of this critical capacity would negatively affect a community's ability to respond to and recover from disaster events.

Medical professional capacity is defined as "the number of health-diagnosing and treating practitioners per 1,000 population" (Federal Emergency Management Agency, 2022). This measure is used in five out of the eight community resilience methodologies, excluding the Resilient Capacity Index (RCI), Social Vulnerability Index (SVI), and Composite Resilience Index (TCRI). The availability of medical professionals, or physicians, in a community is directly "linked with the overall physical and mental health of community residents" (Cutter et al., 2014). A lack of this critical capacity indicates "lower levels of overall community resilience [as shown] by the resulting low birthweight and premature mortality" (Sherrieb et al., 2014). Physicians are an important emergency resource in a community's response to and recovery from a disaster. This measure is related to Hospital Capacity because both indicators represent the capacity of a community's healthcare system and provide emergency medical care during and after a crisis. Affiliation with a Religion is defined as "the percentage of the population that are religious adherents" (Federal Emergency Management Agency, 2020). This metric is used in half of the eight community resilience methodologies, excluding ANDRI, RCI, SVI, and TCRI. Affiliation with a religious or civic organization is used as "a proxy measure for social connectedness and community trust" (Cutter et al., 2014). If there are higher levels of trust present among residents in a community, it reflects how much a "community may be able to rely on the goodwill of other residents, leading to reciprocity and mutually beneficial cooperation" (Cutter et al., 2014). Individuals affiliated with a religious organization can access additional support beyond family and friends, making recovery easier to achieve for these individuals.

The presence of mobile homes is another indicator of community resilience. This metric is defined as the "percentage of housing units that are mobile homes" (Federal Emergency Management Agency, 2022). A higher presence of mobile homes in a community is linked to

"lower levels of resilience because mobile homes are not identified as resilient housing" (Cutter et al., 2014). In general, mobile homes are less secure than built housing. They are not usually fortified with weather-resistant building materials such as concrete or steel. This type of housing is not as able to withstand natural disaster events due to a "lack of basements and the lower-quality construction of these homes, making them particularly susceptible to damage" (Cutter et al., 2014). Public school capacity is defined as "the number of public schools per 5,000 population" (Federal Emergency Management Agency, 2020). It is linked with the population-focused indicator, Educational Attainment (Lack of HS Diploma). Public school systems are "a measure of response and recovery capacity, representing the community's ability to provide safe shelter for individuals and facilitate evacuations" (Federal Emergency Management Agency, 2020). While public schools provide safe shelter to a community, more availability of public schools can also "increase the ability to maintain schooling after a disaster" (Federal Emergency Management Agency, 2020). Public education supports community resilience by aiding social welfare, human development, childcare, stable employment, and democratic solidarity in communities.

Population change is a community-focused indicator that measures "the net migration (international and domestic) of individuals" (Federal Emergency Management Agency, 2020). This metric is used in four out of the eight community resilience methodologies utilized in this study. If a community has large numbers of residents living there for an extended period, then this community is "likely to have strong place attachment, [community engagement], and willing to respond to [restore] a community [back to normal functions] after a disaster" (Cutter et al., 2014). Familiarity among residents can help individuals "navigate a community during an acute crisis, as well as know how to access services after the crisis has passed" (Winderl, 2014). If

there is a fast increase of new residents in a community, it may result in "lower levels of place attachment, less familiarity with local hazards and disaster preparedness, and fewer community connections that could provide additional support during a crisis" (Sherrieb et al., 2010). A decrease in a community's population can lead to a reduction in local tax income and community resources to effectively respond to a disaster event.

Hotel and motel capacity is the least used among the eight community resilience methodologies. The methodologies that use this indicator in its assessment of community resilience include BRIC, CDRI, and RCI. This metric is defined as "the number of hotels, motels, and/or casinos per 5,000 population" (Federal Emergency Management Agency, 2020). A lack of this critical capacity in a community indicates that individuals would have to leave this area during a disaster since "hotels and motels provide temporary shelter to residents" (Federal Emergency Management Agency, 2020). With fewer local hotels and motels, this would make recovery from a disaster more difficult for residents. Rental property capacity is defined as the "rental vacancy rate of total housing units" (Federal Emergency Management Agency, 2020) in a community. The methodologies that use this indicator in its assessment of community resilience include BRIC, CDRI, and DROP. Low numbers of vacant housing units are a positive indicator of economic resilience. However, it is a negative indicator of community resilience because it suggests a "lack of physical capacity to house individuals who have been displaced by a disaster [event]" (Federal Emergency Management Agency, 2020). Higher numbers of vacant housing units provide "immediately available housing stock in a community during a disaster" (Federal Emergency Management Agency, 2020). Thus, residents would not need to leave their community because of a lack of available housing stock.

General Public Survey

The General Public Survey was distributed to the residents of Nueces, Refugio, and San Patricio counties on July 25, 2022, via a Facebook Ad. The Ad was only online until August 8th, giving potential participants two weeks. By using this distribution method, I was able to reach an audience of 6,890 individuals within the study area. I received 2,805 responses on the General Public Survey. However, only 219 out of those responses were valid due to their submission of the consent to participate form. The rest of the responses were therefore deleted from Qualtrics before data analysis occurred. The survey participants were from various communities within Nueces, Refugio, and San Patricio counties. Most participants indicated they were from Nueces County and/or the Corpus Christi area. Other communities and neighborhood/regional areas highly mentioned include Portland, Padre Island area, San Patricio County, Driscoll, Chapman Ranch, Bishop, Calallen, Ingleside, Port Aransas, Agua Dulce, Refugio County, Refugio, and Bayside. Although many participants were from the Corpus Christi metropolitan area, many responses came from individuals who reside in suburban and/or rural areas.

The 15 questions included in the General Public Survey ask about the indicators used in the 8 assessment methodologies that require public input at the municipal level. The General Public Survey Questionnaire can be found in the Appendix for reference. The community indicator data highlighted is critical for these eight methodologies, used at the county and sub-county levels, in their accurate assessment of community resilience. I was interested in learning what different communities in the Coastal Bend define their application of resilience to natural and man-made disaster events as. The purpose of this survey was to learn the local needs, existing capacity, community type, and different hazards present in these communities.

Figure 5 shows the responses received on *Question 1*, which refers to place attachment in the study area. According to the data, about 29 percent of participants have been a resident for 2-5 years, while 26 percent also indicated they have been a resident for 5-10 years. Approximately 21 percent of participants have lived in their community for over 10 years. Communities, that have a larger number of residents who have lived there for an extended period, are likely to "have a strong place attachment, be invested in the well-being of the community before a disaster and willing to respond to help the community recover after a disaster" (Cutter et al., 2014). On average, these communities have a larger number of people who have lived there for a longer period, rather than having more people just move to that area. These communities include Agua Dulce, Bishop, Calallen, Corpus Christi, Chapman Ranch, Driscoll, Ingleside, Port Aransas, Portland, and Padre Island.

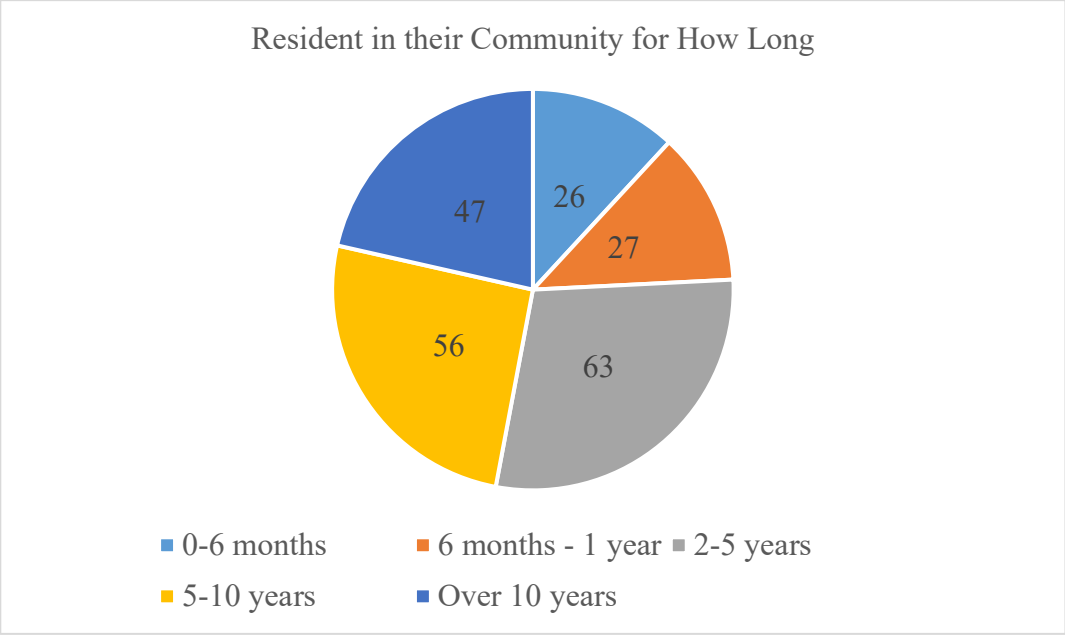

Figure 5: Responses to Question 1 of the General Public Survey

Question 2 was included in the survey to see what hazards are present and not present in the communities within the study area. It attempts to answer one of the research questions: is it possible to apply an all-hazards approach to community resilience assessment at the local level? Among the hazards listed, the following are rated by most participants as a high concern in order: extreme heat, drought, brushfire or wildfire, pandemic, erosion, extreme cold, political insurrection, thunderstorms or lightning, active shooter, terrorism, and hurricanes. Hazards indicated as not a concern to most participants include industrial hazardous materials release or explosion, extended power outage, tornadoes, flooding, cyberattack, an active shooter, thunderstorms or lightning, pandemic, political insurrection, and drought.

Question 3 was about the level of community disruption these hazards present can cause. Most participants rated the following hazards in order as causing high community disruption: extreme cold, drought, terrorism, tornadoes, hurricanes, extended power outage, flooding, bomb threat or explosion, and a pandemic. Compared to these hazards, most participants felt the following would cause no community disruption in their area: extreme heat, storm surge or coastal inundation, earthquakes, an active shooter, a pandemic, industrial hazardous materials release or explosion, extended power outage, and erosion. This question is relevant to the study's outcome, which is developing a methodology to best select a community resilience assessment tool at the local level. It helped highlight which hazards certain communities are more vulnerable to given certain physical, social, and economic factors.

Questions 4A and 4B were about the indicator, Limited English Language Proficiency. 218 participants answered that the English language was their first speaking language. Since no participants indicated the English language was their second speaking language, no participants gave an answer to *Question 4B*. Therefore, this indicator may not be a significant issue among

these participants or in their communities. *Question 5* is related to the community indicator, affiliation with a religion, which requires public input. This indicator can be used as "a proxy measure for social connectedness in a community" (Cutter et al., 2014). As shown in *Figure 6*, most participants indicated they are a member of a religious organization. Members of religious organizations can "access additional support in their community beyond their family and neighbors" (Peacock, 2010). Therefore, these participants have a higher resilience at the individual level given this additional source of assistance they can rely on during times of crisis.

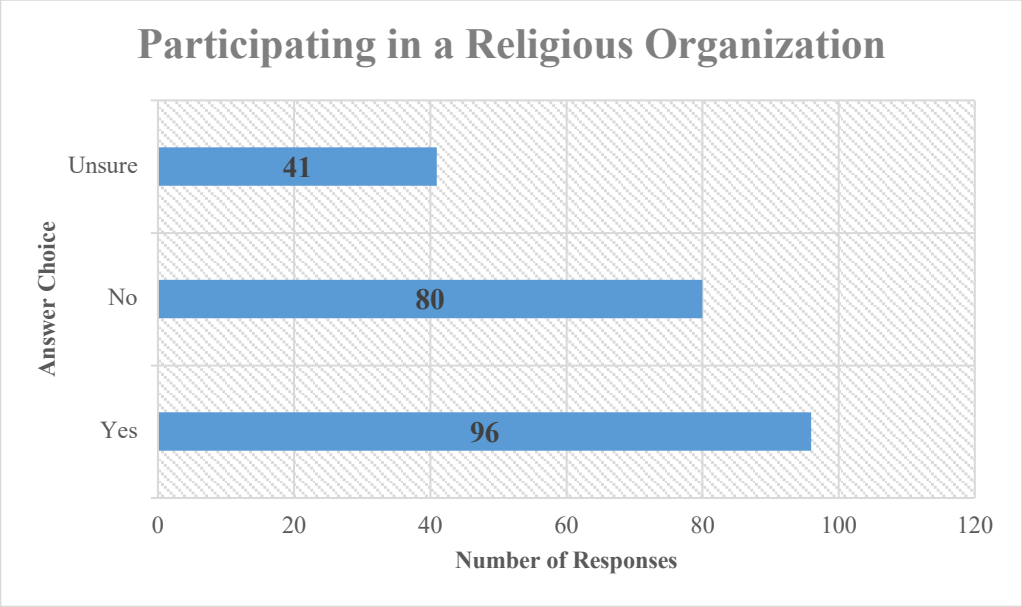

Figure 6: Percentage of Participants who are a member of a religious organization

Question 6A and *6B* was about the indicator, community engagement. If there is low community engagement present with local government, then there is a lack of communication present which will make it more difficult for that community to recover after a disaster event. *Figure 7* reveals most participants are inactively engaging with their local government, while some participants are somewhat actively engaging with their local government. These responses indicated that there is a lack of community engagement in these municipalities. Community

engagement is the first step in building community resilience because it can make more sustainable, long-term change happen where it is needed according to disaster resilience planning. *Question 6B* received some helpful responses on how their level of engagement could be improved. One participant mentioned having more accessible knowledge of government efforts and projects, which would engage newer residents. Another participant from Corpus Christi mentioned that although she volunteers in various community events, she did not believe this access to event participation and volunteering was available to some community members. Another participant mentioned they would be more active if they saw more results from their local government as self-serving partisan politics played a role in him not participating. These responses have suggested there are ways to increase engagement with local government. This would foster communication and increase community trust present between the residents and the local government.

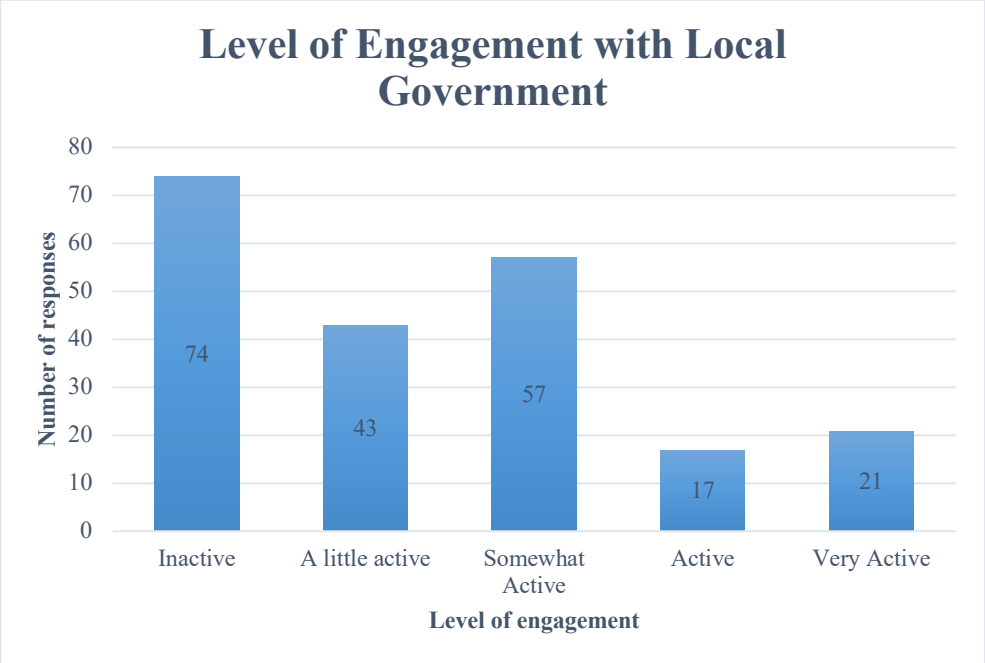

Figure 7: Participants' Level of Engagement with their Local Government

Figure 8 shows the responses received for *Question 7A*. Most participants indicated they have a yearly income in the $50,000-$99,999 range, while some participants indicated their income is in the $100,000-$149,999 range. This question was about the population-focused indicator, median household income. Median household income is important to include in the assessment because it speaks to the percentage of people within a community that can say they have the financial standing to successfully prepare for and withstand a disaster. These responses exhibit a large percentage of participants that may have the financial standing with their current income. For *Question 7B*, 79 participants indicated they do not believe they have financial standing, while only 55 participants think they do. However, most participants were unsure of their individual financial standing in an emergency. Most participants who answered 'no' reside in the Nueces County or San Patricio County areas.

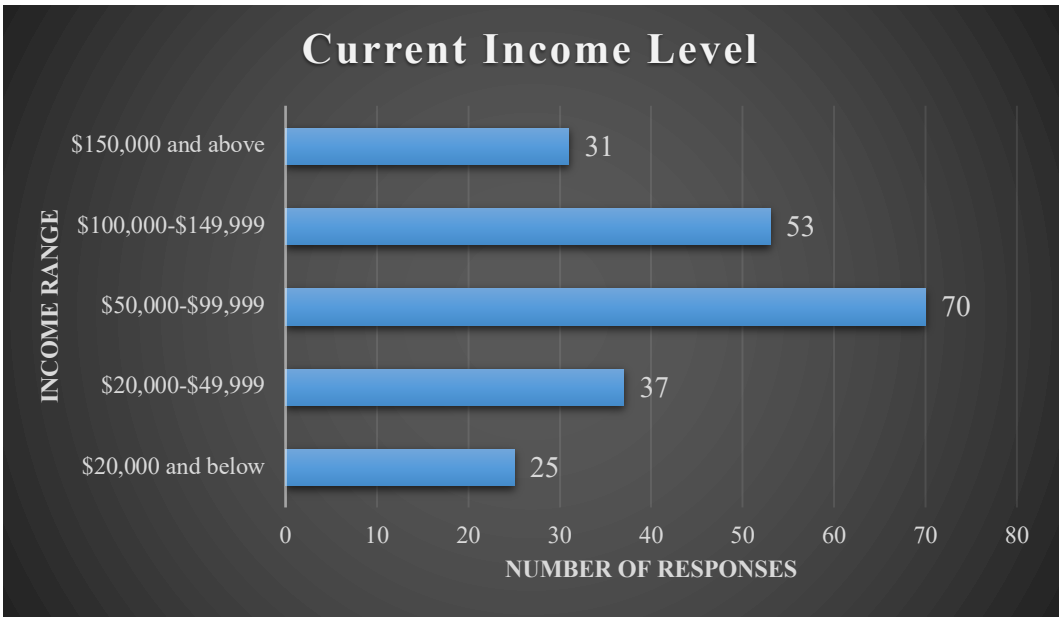

Figure 8: Participants' Current Income Level Graph, based on ranges provided in Question 7A

Question 8 was about the current accessibility to resources households may have in a community. As shown in *Figure 9*, most participants agreed that the following resources they

have or have access to are public parks, public schools, internet, cell service, health services, air conditioning, and electricity. Most participants indicated they do not have stable access currently to the following resources: financial assistance, drinking water, public latrines or toilets, internet, civic and social organizations, roadways, and health services. Most participants also mentioned they do not have access to financial assistance, gas, civic and social organizations, public latrines or toilets, drinkable water, electricity, and roadways. These responses highlight the lack of stable, reliable accessibility to certain resources present in some communities in the study area.

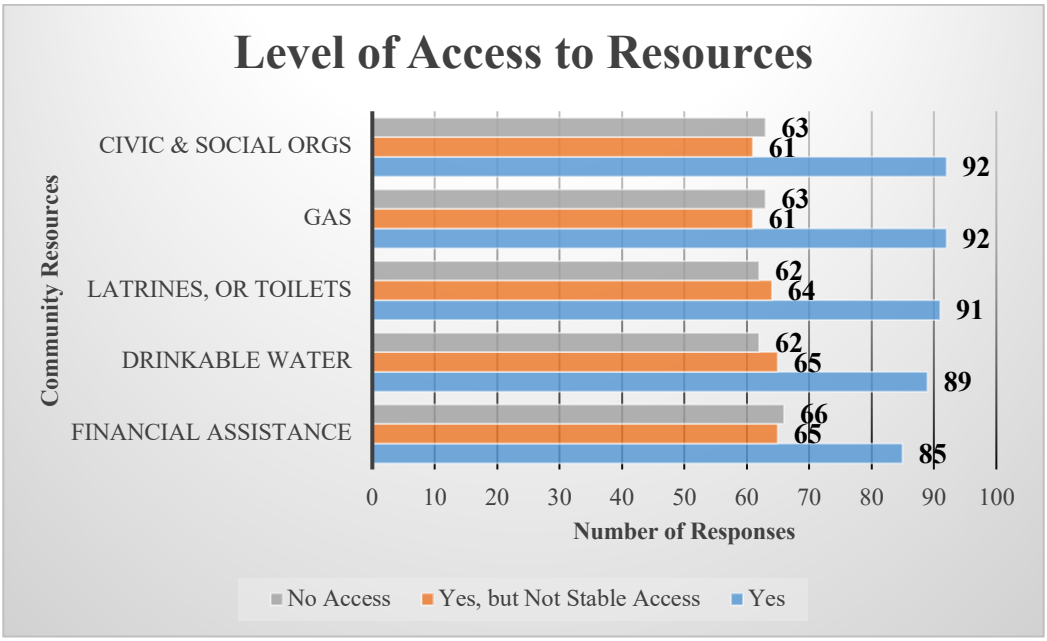

Figure 9: Level of Access to Resources for a Household

Question 9 was about medical professional capacity. Availability of and access to physicians is a critical emergency resource in the response to and recovery from a disaster. If health services are far away from individuals in an area to use during an emergency, it indicates low community resilience because less availability of physicians is linked to the overall physical and mental health of residents. While 8 participants mentioned a hospital or clinic is less than 5

minutes away from them, 13 participants indicated one was 5-10 minutes away. 6 participants mentioned one was 10-15 minutes away, and 5 other participants indicated one was 15-20 minutes away from them. 12 participants mentioned a hospital or clinic is 25 minutes or more away. Although a good number of participants have health service facilities less than 10 minutes away, there were also some participants mentioning these same facilities were 25 minutes or more away from them, which makes them more difficult to access and makes them more vulnerable to disaster events.

Question 10 was about the community-focused indicator, Public School Capacity, which is normally difficult to obtain at the local level. Public schools represent a community's ability to provide a safe shelter for individuals and help evacuation operations in a community run more smoothly. 46 participants gave a response, with most of them mentioning a public school is less than five minutes away from their residence. 11 participants indicated one is 5-10 minutes away. 4 participants mentioned one is 10-15 minutes away from them, and 5 participants mentioned one is 15-20 minutes away. Only 6 participants specified that a public school was more than 20 minutes away from their household. These participants are from smaller towns and more rural areas, which include the communities of Agua Dulce, Bishop, Chapman Ranch, Corpus Christi, Ingleside, Driscoll, Bayside, and Violet.

Question 11 was about the presence of mobile homes in a community, as these types of homes are more vulnerable to the effects of natural disaster events. The presence of mobile homes is the percentage of housing units that are mobile homes. A mobile home is defined as a movable or portable home connected to utilities without a permanent foundation. Only 63 participants mentioned they were living in a mobile home. 153 participants indicated they did not live in a mobile home, which does not hinder their resilience to disaster risk. *Question 12* is

about another community-focused indicator, hotel and motel capacity. Hotels and motels can provide housing to individuals who must leave their homes, either to find safe shelter from the disaster or as temporary housing during recovery. The results shown in *Figure 10* reveal with fewer hotels and motels in their area on average, most participants cannot rely on them as another emergency housing resource during or after a disaster event.

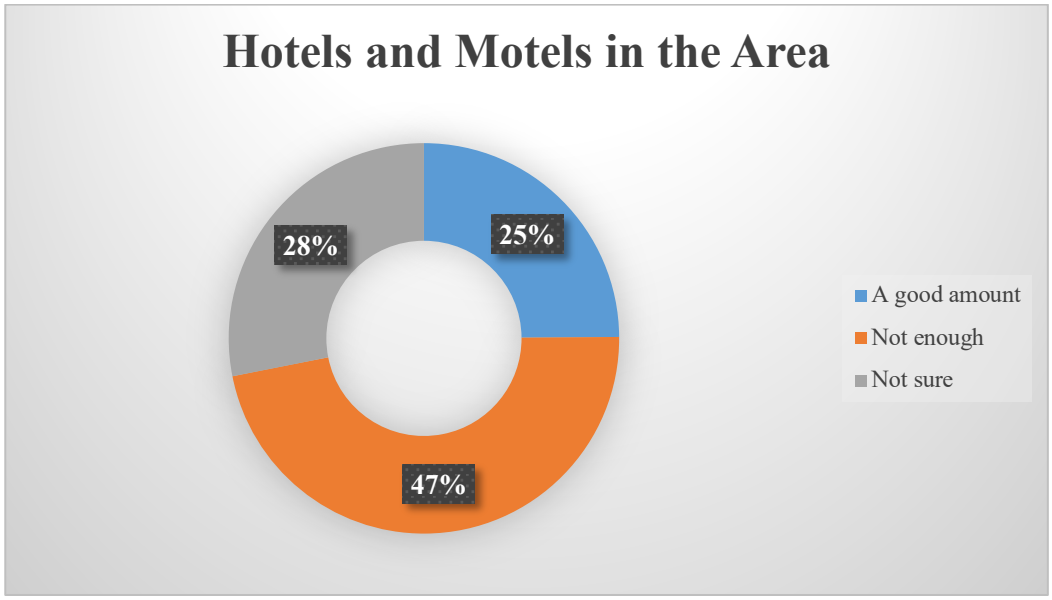

Figure 10: Amount of Hotels and Motels in the Area

Question 13 was about the community-focused indicator, connection to civic and social organizations, highlighted as a core indicator shared among the eight community resilience assessment methodologies analyzed and used in this study. A higher level of participation in civic and social organizations in a population increases networking and trusted relationships in that community. Examples of civic and social organizations include non-profit social clubs, alumni organizations, societies, and associations. *Figure 11* portrays that most participants are unsure of or do not participate in civic and/or social organizations in their community. With a

lack of participation, the results indicate these participants cannot use these organizations for help or provide mutually beneficial cooperation during a crisis.

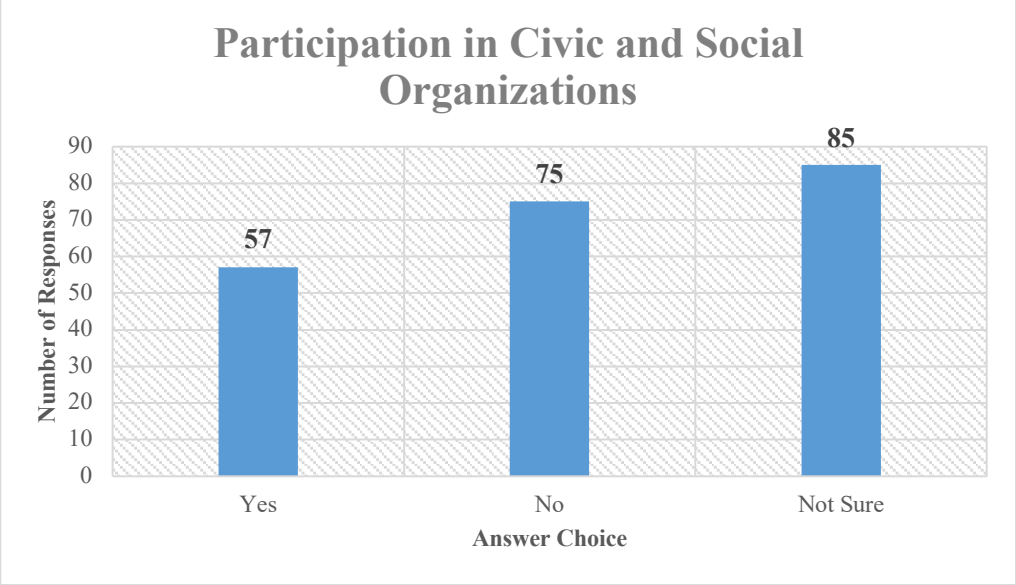

Figure 11: Participation in a Civic and/or Social Organization

Only 20 participants offered an answer to *Question 15*. Among these responses, many participants mentioned needing a generator, a lack of evacuation routes in their area, having family in their household makes it difficult to evacuate, lack of public transportation, how personal health and physical ability play a role in individual disaster resilience, and the community's response time to a disaster. A couple of responses stood out during data analysis. One participant mentioned preparedness means having supplies on hand, not assuming stores will be open for food or gas stations will have gas available. Another participant indicated having a savings account or credit card with room to spend can help someone withstand a disaster event. By having less financial assistance or of less financial standing, it is more difficult for that individual to deal with disaster risk. One participant, from the Padre Island area in Nueces County, stated there are limited exit routes in that area, and evacuation routes are a deep concern

during mandated evacuations. Other survey participants also from that area mentioned this being an issue that affects their ability to withstand disaster risk as well.

Public Officials and Stakeholders Survey

The Public Officials and Stakeholders Survey was distributed to the curated email distribution list created on July 25, 2022. It was closed to potential participants on August 22, 2022, after four weeks. During that time, I received a total of 10 responses. Although this is fewer responses than anticipated, these participants work for different organizations in different roles. Their occupations include mayor, city manager, city council member, city planner, county judge, disaster recovery manager, county deputy EMC, and chief strategy and sustainability officer. Various organizations were represented in these responses including the City of Portland, the City of Corpus Christi, the Port of Corpus Christi, Refugio County, Nueces County, Coastal Bend Council of Governments (CBCOG), Nueces County Development Authority, and the Coastal Bend Disaster Recovery Group. Three participants represented rural areas, four participants represented urban areas, and three participants represented suburban areas. Four responses also noted they serve or represent more than one type of area or community.

This survey had a total of 23 questions relevant to community resilience and disaster mitigation. The purpose was to gain a more localized perspective on how one community resilience assessment tool would best suit local needs, existing capacity, community type, and different hazards. I was interested in understanding different methods of community resilience measurement, the indicators behind it, and how community characteristics, present needs, and hazards present play a critical role in assessing a community's resilience. Certain questions had the specific purpose of gaining more information on indicators that require public input.

Question 1 was about the participants' time in their official role serving their community. A few participants reported they have been working in an official capacity in the past 1-2 years. Other participants have been in their current role for a long time, with the answers of 7.5 years, 15 years, and 19 years, being the longest. Other answers received from two participants range from 3.5-4 years working in their role for their community. *Question 2* and *3* was concerned with participants' knowledge of the concept of community resilience and the various methods available for its assessment. Although all participants indicated they were familiar or somewhat familiar with community resilience, most participants said their organization can or somewhat could conduct an assessment of its community's resilience. A few others indicated they do not have that ability or were not sure.

Question 4 received 5 'yes' responses and gave various explanations as to why they answered yes. Only 2 participants replied maybe to this question. The City of Portland's council member recalled there are very disparate areas in coastal counties, and what these coastal towns need is different from the needs of inland rural areas. A few participants in the Corpus Christi area mentioned how their community is diverse, and this makes the assessment of community resilience difficult as a result. Nueces county is made up of urban and rural areas, and San Patricio County has industrial and agricultural economic influences. Participants also mentioned that size, different cultures, and geographical location are important factors to consider. The Port of Corpus Christ's Chief Strategy and Sustainability Officer voiced how physical infrastructure is built at a more granular, site-specific scale. For example, land-use codes are written at the local level, and there are multiple communities within a county. Various factors that play a role in a community's resilience must also apply to all community types and their pre-existing conditions.

5 participants answered yes to *Question 5*, while 2 participants answered maybe. A senior city planner for the City of Corpus Christi mentioned her answer was maybe because adaptation to these types of communities would require a significant commitment from a contractor or researcher. The participant explained further that smaller communities are going to be more concerned about immediate needs, so preparing long-term visioning tools with more local-level information would be more applicable. *Question 6* was about the level of public engagement their organization has received in disaster response, recovery, and/or mitigation. *Figure 12* shows most participants have a higher level of public engagement, while only 3 participants indicated their organizations have little to some public engagement.

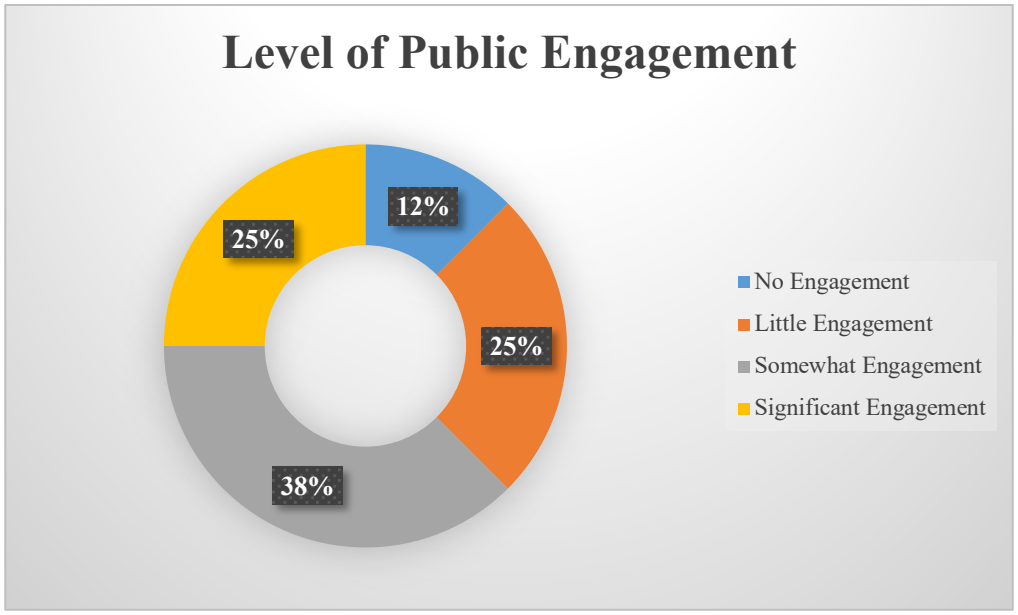

Figure 12: Level of Public Engagement with Organizations

Question 7A was about the level of difficulty their organizations may have in obtaining community engagement in disaster response and recovery efforts. As shown in *Figure 13*, most participants' answers were divided on this question for the most part between Very Difficult to Somewhat Difficult in obtaining community engagement. Otherwise, only two participants rated

obtaining community engagement in their efforts as not difficult. These results indicate that these government and community organizations have trouble obtaining engagement from their residents, which shows a lack of community trust. With this lack of communication present between the two, local governments cannot promote sustainable, more informed decisions without recognizing and communicating the needs and interests of all residents and entities in a community. No participants answered *Question 7B*.

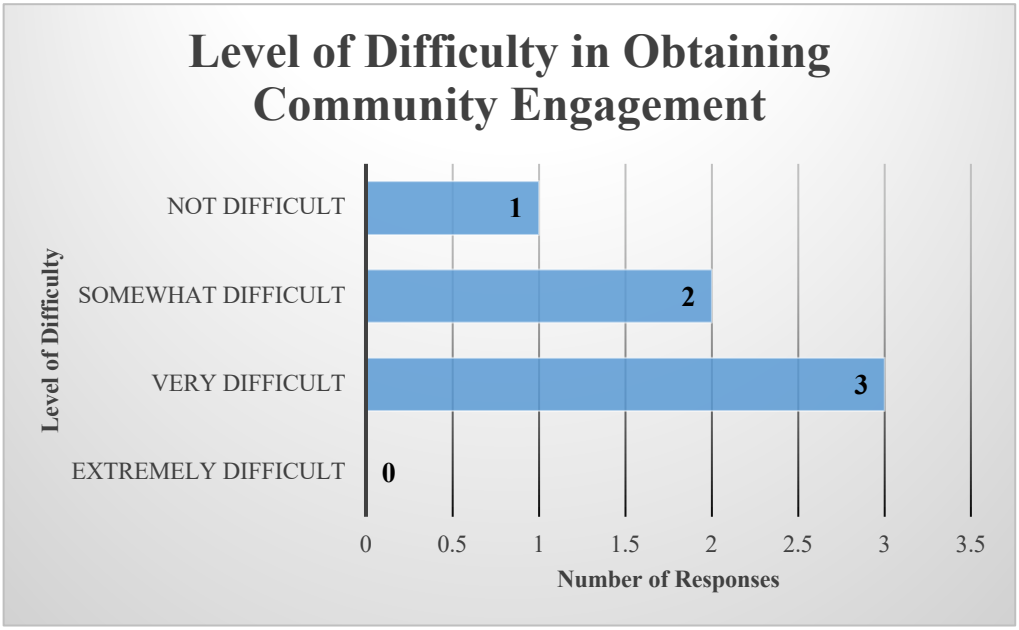

Figure 13: Level of Difficulty in Obtaining Community Engagement

Question 8 focused on how human crimes in a community should be, and sometimes are, included in community resilience assessment as a man-made disaster risk. *Figure 14* shows a couple of pre-stressors that stood out during data analysis as significant issues in the participants' communities. These pre-stressors include domestic violence, substance (drug) abuse, violent disputes, gangs, and vandalism. Others such as burglaries, prostitution, robberies/assaults, teen pregnancy, and child abuse were identified to the best of their knowledge as not prevalent or significant issues in their community. A key aspect of assessing resilience in a community is

trust. If there are multiple pre-stressors largely present in a community, it indicates the level of trust and safety in that community. It also stipulates a subsequential decrease in the community's quality of life.

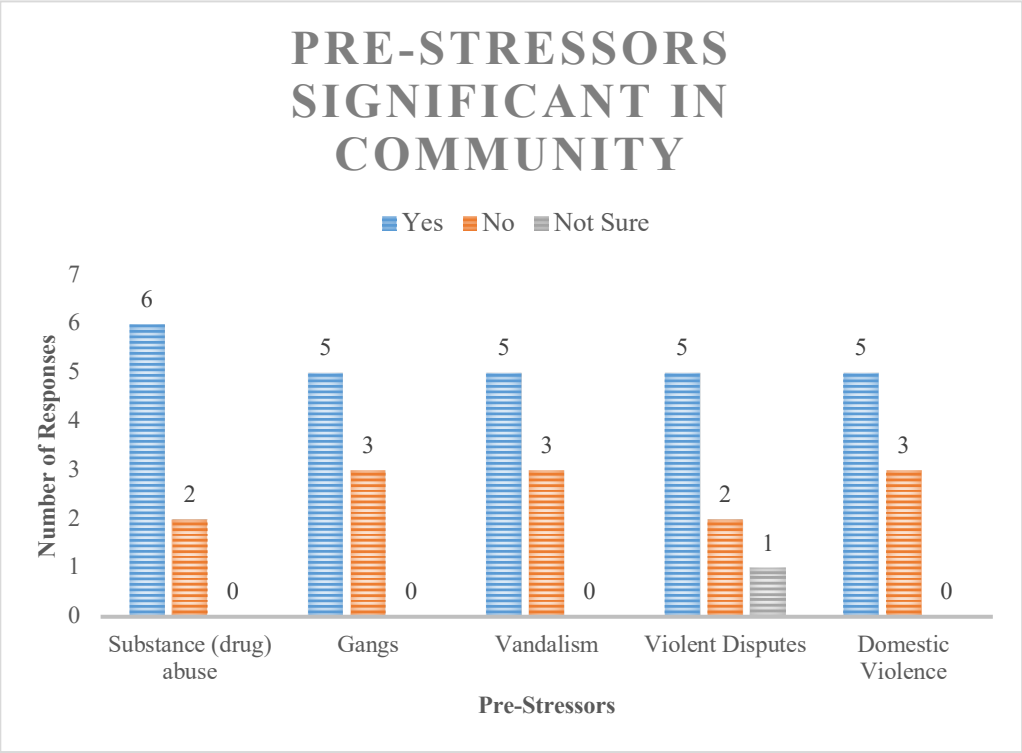

Figure 14: Pre-Stressors Significant in Participants' Communities

Question 9 was about the overall quality of life of the people living in the participant's community. Four participants indicated their opinion that their community's quality of life has improved, while two participants indicated it remained the same for their community. The last two participants who answered this question indicated their community's quality of life has worsened. *Question 10* was concerned with the possibility of considering all shocks and stressors in community resilience assessment. Thinking about the 'holistic' resilience assessment, four participants agreed on this possibility by answering "yes", while 3 participants think it may be possible as indicated by their answers. Only one participant disagreed with the others.

Responses received for *Question 11* are shown in *Figure 15* below. Indicators that were highlighted in these responses as difficult to obtain at the local level include Flood Insurance Coverage, Medical Professional Capacity, Presence of Mobile Homes, Connection to Civic and Social organizations, Percentage covered by a recent Hazard Mitigation Plan (HMP), Limited English Language Proficiency, and Affiliation with Religion. This means that these indicators will present an issue in assessing a community's resilience. Other indicators, such as voter participation in recent elections and corporate tax avenues, are not as difficult to obtain from a community according to participants. Percentages of the population covered by a recent Hazard Mitigation Plan (HMP) and participating in the Community Rating System for Flood (CRS) are not as readily available for assessment purposes at the local level as well.

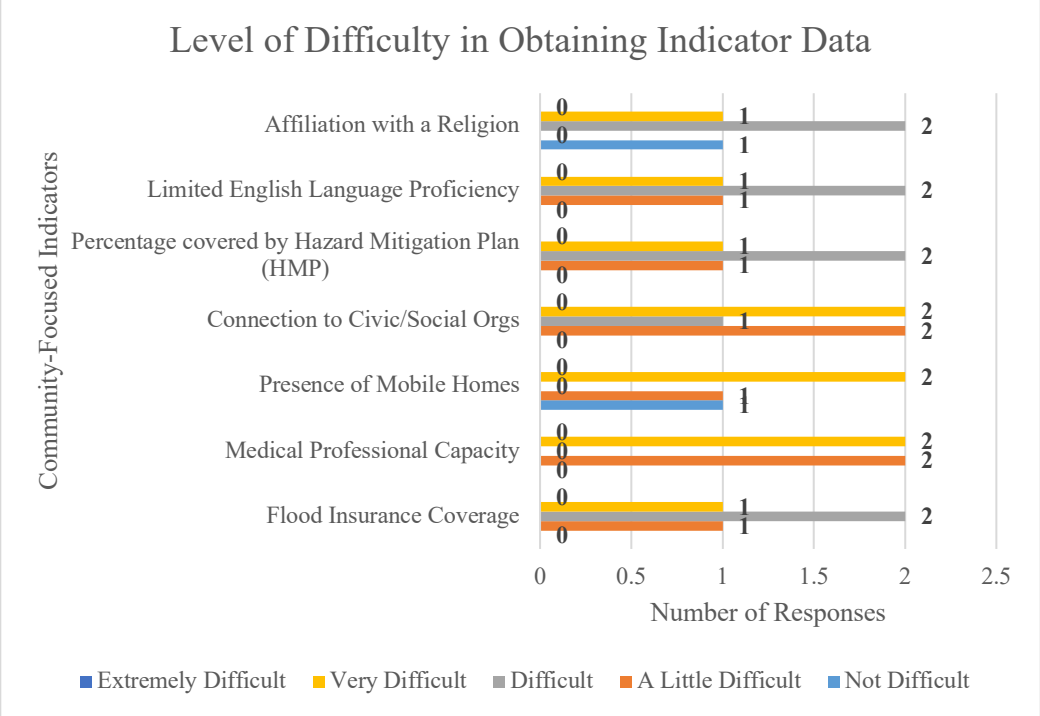

Figure 15: Level of Difficulty in Obtaining Indicator Data for Community Resilience Assessment

Question 12 received a total of five responses. Some indicators that were noted in these responses include civic organization, religious participation, voter participation, single-sector employment percentage, and limited English language proficiency. One participant commented on how if a community is participating in CRS, then 100% of that population is covered so this might be better clarified in the future as a percentage of flood insurance policy holders receiving CRS credit on their policies. Another participant mentioned a lack of resources, training to collect the data, and/or the availability of the data as indicators that should be included in assessment tools as ones that require public input. *Question 13* was concerned with what information sources these participants, or their organizations use to engage the public. Most participants use newspapers, social media platforms, word of mouth, and public council/government meetings as their main sources of information to engage the public in these efforts. Government documents, city or county websites, and television broadcasting are other sources of information that a few participants noted they use as well to engage the public.

Question 14 went more into depth on the trusted sources of information most people in the participants' community use. 6 participants answered yes to this question, while only 4 of them clarified their answer. 2 respondents mentioned social media platforms are the most used, while the other two answered TV broadcasting and word of mouth through government and non-profit organizations. *Question 15* was interested in learning more about these communities' ratio of large to small businesses, or their business environment. According to the results, most participants answered "no", while two participants noted their community does have a diverse business environment. The responses received on *Question 16* indicated that most participants could travel in case of an emergency during a storm. 3 participants' communities are accessible by car during a storm, while the other two participants indicated that less than half or very few

parts of their community are accessible. *Question 17* was about the indicator, access to medical resources. All participants answered yes, they do have access to a hospital or medical clinic. According to the results from *Question 18*, most participants indicated these medical supplies and resources listed are in sufficient supply in their community's health clinics and/or hospitals. One participant from Nueces County indicated the following medical supplies and resources were insufficient: patient beds, ambulances, physicians, nurses, and other health staff. Another participant from Portland noted that patient beds were not available or in short supply in their medical facilities.

Question 19 was focused on learning more about these communities' current access to mental health services. Mental health support is an indicator of community resilience because it speaks to the level of life satisfaction in a community. 5 participants noted their community has one or more mental health support facilities, while 1 participant from Portland mentioned they did not have a mental health support facility currently. *Question 20* was about the current water supply in these communities. A community's water supply is an important indicator of community resilience because it reports the level of access these citizens have to a critical resource. According to the results, 4 participants answered their current water supply is insufficient, while 3 participants noted their community does have a sufficient water supply. For *Question 21*, 5 participants were unsure if the community residents were in general covered by a National Flood Insurance Program (NFIP) policy. Only 2 participants noted their community is entirely or mostly covered by an NFIP policy, in which most or all residents are NFIP policyholders. *Question 22* was concerned with finding more about the indicator, percent of the population participating in the Community Rating System for Flood (CRS). Most participants

did not know their community's participation status with the CRS. 2 other participants mentioned their entire community or most of their community is participating in the CRS.

Focus Group Sessions

During this study, I conducted two focus group sessions on Friday, September 30, 2022, with the residents of Corpus Christi and Portland who participated. The Corpus Christi focus group was conducted from 1:00 to 2:00 PM. For this focus group, a total of 4 participants attended this session. The Corpus Christi focus group participants only answered 9 out of the 12 questions asked within that time because we engaged in rich discussion on certain question topics. The Portland focus group was conducted from 3:00 to 4:00 PM. For this focus group, a total of 3 participants attended this session. All 12 questions received answers from each participant as more response time was given with a smaller group of participants present. This was a bonus because it gave me more time to get to know these participants and how their backgrounds relate to the answers given for each question.

These 12 questions were included specifically to gain information about community-focused indicators that require public input. These indicators include population change, political engagement, medical professional capacity, health care and mental health support, community engagement, trust with government, community safety, the ratio of large to small businesses, evacuation routes, difficulty accessing services, individual preparedness, and volunteering. *Question 1* was about place attachment within these two communities. Within the Corpus Christi focus, all participants mentioned they have lived there for more than five years. 3 out of 4 participants said they lived there for 14-15 years, indicating a higher level of place attachment present. Within the Portland focus group, two participants said they lived there for less than five years, while one participant said he has lived there for more than five years.

With the results of *Question 2*, all participants in the Corpus Christi focus group answered that they had no issue in voicing their opinion and needs to their local government, but they were not confident that all their needs will be met. Most participants agreed their local government was doing the best it can, but the average citizen isn't always heard at the local level. One participant identified current infrastructure and bad roadways as current issues. When little is done to resolve these issues, she asked what this implies to voters when nothing gets done. This participant s under the impression that this is one of the reasons why voter participation is low. One participant said to think of disaster response and recovery as a porous wall with non-profit organizations and churches trying to fill the holes. When resources are strained, these organizations and associations work to provide support in times of crisis where the local government sometimes cannot promptly. Another participant identified herself as having an insider view with her being the chair of a local government board. She mentioned there are a few issues with the current system, highlighting that citizens with time and money are usually the ones that are heard at the local level. She made a few suggestions on how this can be improved: have information accessible to everyday people; make the issues in the community clear with identified trustworthy information sources the people use; and have more people vote to voice their opinion on these current issues. During the Portland Focus group, one participant indicated his engagement with the government is average, but he thinks that they can do better. All participants mentioned they have more positive thoughts towards their local government and feel their needs are generally or mostly met. One participant mentioned her thoughts on how Portland is growing too fast and how they must adapt as they go with a growing population. Another participant mentioned there were also TCEQ violations in the past brought against the

Portland-Corpus Christi area's water system and Voestalpine, an iron processing plant in Portland, for iron ore dust found in and around residences in the area.

Question 3 was concerned with the difficulty of accessing government services and resources in their communities. During the Corpus Christi focus group, two participants noted they have not had any difficulty. One participant mentioned that she saw a shooting occur recently across the street from her. She reported it to the authorities, but the police took an hour to show up and did not offer much help as they were on their phone most of the time. Another participant told the group a story about an experience her mother had recovering from Hurricane Harvey in 2017. Living in a vulnerable neighborhood in Corpus Christi, her mom was living without electricity for five months, and she did not have the money to hire anyone to fix the damage sustained on her property. The participant further noted that although the city knew and did not listen to her complaints, her mother's electricity was not restored until she paid an expensive fee out of pocket. In the Portland focus group, one participant indicated he has not experienced any difficulty, while another participant indicated he does sometimes have difficulty. The third participant mentioned her recent trouble with animal control in her neighborhood and referred to an incident that occurred a few months ago with her daughter getting bitten by a stray dog. Her family had to take their daughter to a hospital thirty minutes away in Corpus Christ after being denied entry to three nearby emergency clinics because they did not have the supplies to properly care for her.

Question 4 was about individual resilience and how it plays a role in community resilience because healthy, socially connected, prepared people make for stronger communities able to withstand disaster risk. During the Corpus Christi focus group session, the first participant indicated he is optimally prepared for future disaster events, and the second

participant said she is self-prepared but not when it comes to her family living in her household as well. The third participant also mentioned that she and her husband also prepare for the children and parents-in-law as well which makes it harder. During the Portland focus group session, two participants indicated that they are prepared or mostly prepared for future disaster events. The third participant said she is only half prepared, for hazards that do occur in her area and not for hazards that do not normally occur such as tornadoes and earthquakes.

Question 5 was concerned with the participants' familiarity and knowledge of emergency shelters in their area. During the Corpus Christi focus group, one participant highlighted that access to emergency information is the weakest part of the system. He used Hurricane Katrina to portray a lesson learned in the emergency sector about using a management system to be more effective. One participant mentioned she does not know, but she has not had to use this resource yet. She highlighted that individuals who need this information do not have access to the information technology used by the local government to get the word out. Another participant indicated she did not know their location because she and her family plan to evacuate since they have the means to do so. One participant mentioned that those who do not have internet access have access to public places, such as food banks and city halls. The other participants agreed that word of mouth or putting up flyers and posters should also be considered when distributing emergency information to people in need. During the Portland focus group, all participants said yes to knowing the location of safe shelters and agreed that the city is overall great with posting information and updates. With the responses given during both focus groups, I interpreted these results as both communities not having an issue with accessing emergency information online.

Question 6 wanted to identify if there was an evacuation route close to these participants. In both focus group sessions, all participants who attended answered 'Yes' with a few

mentioning they have an evacuation route close by. Evacuation routes is a community-focused indicator used in two or more of the eight methodologies analyzed, and it measures major road egress points per 10,000 people. These results can be interpreted as the citizens of both communities not having much of an issue with evacuating in emergency and/or mandatory situations. Afterward, I inquired if any participants had voted in the recent local, state, and/or federal elections. During the Corpus Christi focus group, one participant noted he voted in the recent state and federal elections, and another participant mentioned she has voted in the recent federal elections but not in every small local election. One participant also noted she does not have a good track record with voting because she is under the impression that her vote does not matter. The last participant mentioned that she has voted in all recent elections (federal, state, and local). During the Portland focus group, only one participant said 'Yes' to *Question 7*, while the other two participants either did not vote in the recent local and state elections or did not vote because one participant did not know if she can due to her citizenship status. A higher level of voter participation indicates a higher level of community engagement present, enhancing overall community resilience.

Question 8 is about the indicator, volunteering, which is the percentage of the population undertaking voluntary work to support their community. During the Corpus Christi focus group, two participants both mentioned they partake in volunteer work, while one participant noted she does not volunteer because it is difficult for her to find the time. During the Portland focus group, all three participants answered they volunteer whenever they have time. One participant mentioned his passion for volunteering with kids and noted how the next generation should be prioritized because they are the future of our communities.

Question 9 was included to learn more about their communities' current access to medical services. During the Corpus Christi focus group, all participants agreed that mental health services are woefully behind and lacking in availability. For pediatric patients, they are shipped out of town to another facility that provides this type of in-patient care. One participant mentioned that accessibility to ambulances is limited, and another participant highlighted medical insurance as an issue hindering access to medical care. With medical bills as expensive as it is today, it is also making accessing these medical services difficult for people who have health care insurance. Physician availability is also declining in terms of making sure a facility has enough staff to take care of patients. One participant agreed with what the other participants said, also mentioning that dental health care is an issue with expensive costs that the average person pays to see a dentist regularly. According to the results received during the Portland focus group, all participants mentioned what issues are prevalent in their area that are associated with the accessibility and availability of medical services. One participant indicated he has issues with close-by primary care, and he believed that emergency care in the area can be improved. Another participant admitted that health care for the disabled could be improved, as well as the current access to mental health services. He also noted that since their population is increasing, hospital capacity and medical professional capacity need to be expanded and improved at the same time for these facilities to be able to take in a larger number of patients per day. One participant highlighted urgent care as being an issue, with Portland not having a place like a hospital for its citizens to use and not having many specialty doctors to go to for specialized medical care.

Question 10 was about the indicator, the ratio of large to small businesses in a community. Small businesses help support their local communities by donating, volunteering, and participating in local community events. When there is a higher number of small businesses

present, it indicates a community's resilience is enhanced by having more community support available. During the Portland focus group, all three participants agreed that Portland has more large businesses and industries when comparing this number to the general population and their employment. *Question 11* refers to community trust and safety. Community safety is the age-standardized number of people per 100 population who feel safe walking in their neighborhood during all hours. During the Portland focus group, one participant indicated that he feels safe walking day or night in the vicinity of his house, and it is easy to know where the safe areas are there. Another participant mentioned that he felt safe in his neighborhood like the first participant, but he in general does not trust people and has had a security issue with locking up his bike in public areas. The last participant also said she feels safe in her neighborhood, but she did not feel safe with the stray animal issue prevalent in her neighborhood. She further mentioned that since Portland is not a small town anymore, certain areas require more lighting for walking at night. According to the results received for *Question 12*, all participants said they either have not been around during disaster events in the area or have not been a victim of the impacts of various disaster events. One participant mentioned they are not comfortable with relying on the community in times of crisis, and another participant mentioned that the electrical grid needs to be improved because of her experience during the Texas freeze on February 10-19, 2021. She did not have power for weeks at her house. This was the cause for most people in Corpus Christi during that natural disaster event.

All three participants offered additional comments on what they think are prevalent issues and their accessibility and availability of resources. One participant noted since she moved to Portland, she has witnessed the community be more trusting with each other. She further went on to highlight Portland beaches are currently not safe for the public because there have been

reports of people breaking into cars. She also stated that one way to attract more families to move to Portland is to have more activities for the kids to do on weekends. Some organizations host group activities for families and kids, but they are hard to find for new residents. Another participant said it is not easy for non-emergency information to be shared. Another issue he mentioned is the present difficulty for local businesses to open due to supposed bias within the local government. With the results given, I was able to accomplish gaining more information on community factors and hazards present and the community-focused indicators used in the assessment of community resilience. I learned more about the prevalent issues, local needs, and existing capacity in these two communities that may affect their ability to withstand disaster risk.

CHAPTER IV: DISCUSSION

With the effects of climate change increasing in strength and occurrence, addressing these threats is needed to strengthen a community's adaptive and coping capacities. This could be achieved by applying an approach combining the knowledge of preparation for disasters with actions that can be taken to strengthen a community's resilience. That is where building community resilience comes into play. It is an important concept in disaster mitigation because it involves improving, adapting, and "building on an interconnected network of systems that directly impact human society at a grassroots community level" (Fitzpatrick, 2016). The application of community resilience is different in every community because of their unique characteristics and what hazards they face. This is one of the reasons why measuring community resilience is vital. There are many frameworks and tools available to communities that offer different methods, but many communities lack the resources to implement resilience measurement and find it difficult to identify which tool to use at the local level. Although community-focused indicators are considered in all assessment methodologies, they rely on county and U.S. census tract data because of the lacking availability of community-level data. This research study addresses this issue by adopting a more localized approach to community resilience measurement and offering a methodology to local communities of different types and sizes on how to select the best-fitting resilience assessment tool at the local level.

During the case study analysis, I collected the necessary data through the distribution of two surveys and conducted two focus groups. These data collection instruments used in the study area have different targeted audiences within the study area: residents in the communities and counties identified and the public officials and other key community leaders that represent their interests and needs. By doing so, I gained a more localized perspective about what makes a

community "resilient" from individuals with different backgrounds and occupations. Their purpose was to gain more information on community resilience indicators that are not available or difficult to obtain at the local level, local needs present in each community within the study area, the existing capacity of these local governments to prepare for and mitigate disaster risk, and what hazards present a risk to their community. This was achieved through these efforts, and the results collected answer the three research questions identified in the *Research Objectives subsection* of this manuscript.

The first research question asked if community resilience could be improved if a methodology to select the best resilience assessment tool was available at the local level. This was answered more directly by the results of the Public Officials and Stakeholders Survey. Community factors such as size, diversity, different cultures, and geographic location were highlighted as important to consider when assessing a community's resilience and deciding which resilience assessment tool to use. With the results received, the following community-focused indicators were highlighted among various participants as either a concern or difficult to obtain at the local level. These indicators include access to medical resources, political engagement, community safety and trust, and the ratio of large to small businesses. This information learned has been applied to the methodology I recommend based on the work I have done during this study. This will help localities that lack the resources to implement community resilience measurement and conduct an analysis of assessment tools required before execution. If this knowledge and expertise were already available on the ground floor, local governments would be more inclined to conduct a community resilience assessment themselves rather than bringing in a third-party contractor.

By developing this methodology using the results obtained, I managed to accomplish the study's research objectives. I accomplished the first research objective by conducting a literature review on the different methodologies used to assess community resilience and used this knowledge to compare the strengths and gaps of each correlated to the indicators used along with other factors. In FEMA's 2020 and 2022 updates of the Community Resilience Indicator Analysis, the selection criteria identified by this project to select resilience assessment methodologies to analyze is also somewhat utilized in this study. The following is the methodology I developed based on the data collected and analyzed. The methodology includes the following steps for local governments and other applicable end-users to utilize when assessing resilience at the municipal level:

- Identify a community's local needs, existing capacity, and what hazards they face before assessing and comparing community resilience assessment methodologies.
- Assess the community resilience assessment methodologies used in this study and their indicators. Add additional methodologies if applicable. Then narrow down the selection of methodologies based on the following selection criteria: the number of core indicators shared with other methodologies, unit of data analysis (national, state, or local), general availability of data, general risk focus, pre-or post-disaster focus, and applicability to different communities (including small town, rural, and underserved areas). By doing this process of cross-elimination, the end-user will be able to pinpoint community resilience assessment tool(s) that are not already highlighted as applicable for use at the local level.
- Once data availability is identified, the end-user can select the best resilience assessment tool for their community from the available tools and data collected and analyzed.

CHAPTER V: CONCLUSION

The existing research and analyses on the subject rarely factor in all community characteristics and apply to different threats a community may face when assessing a community's resilience. The ideal community resilience assessment tool to use at the local level would help them identify their needs, the resources they have available at their disposal, and what funding opportunities they need to prioritize to meet their identified needs. I had this in mind while developing the methodology to select the best-fitting resilience assessment tool at the local level. Although the results of this study aim to ease the burden of implementing community resilience measurement at the local level, communities will have to decide if a resilience assessment tool is right for them based on their local needs, existing capacity, and unique community characteristics.

The results of this research contribute to existing research by giving a localized adaptive approach to the broader community when choosing the best community resilience assessment tool that suits their community's needs and factors in their unique community characteristics and existing capacity. By obtaining more community-focused measures and gaining the local perspective through the surveys and focus groups, the methodology furthers the advancement of building on and improving community resilience at the local level. Measuring community resilience can be confusing enough, especially with the large number of assessment methodologies to choose from. This methodology created by this research can help communities on the ground by giving underserved communities lacking the resources to implement resilience measurement a tool to help select a community resilience assessment methodology based on community factors, needs present, and existing capacity. For future reference, I have three recommendations I would like to share with the broader community. The first recommendation is to identify what indicator data exists and what indicator data may prove difficult to obtain at the

local level. To obtain information on data inaccessible online or difficult to obtain, I suggest the following methods for local governments to utilize during resilience measurement: conduct a survey questionnaire with residents and provide a participation incentive, use a town or city hall meeting to ask questions about community-focused data to residents, or form a partnership with an interested third party (universities, research institutions, other county or regional governments) to have assistance in gaining this indicator data. There is room for doing more analysis or research on the data with certain questions that had different answer choices, such as fill-in and matrix table questions. Due to open-ended responses, I recommend further content analysis on understanding the public's ideas in the future.

REFERENCES

Agency for Toxic Substances and Disease Registry. (2021, August 30). “CDC/ATSDR Social Vulnerability Index Fact Sheet”. Retrieved October 06, 2022, from https://www.atsdr.cdc.gov/placeandhealth/svi/fact_sheet/fact_sheet.html.

Berardelli, J. (2019, July 8). “How climate change is making hurricanes more dangerous”. Yale Climate Connections. Retrieved September 27, 2020, from https://yaleclimateconnections.org/2019/07/how-climate-change-is-making-hurricanes-more-dangerous/.

Cutter, S. L., Ash, K. D., & Emrich, C. T. (2014, September 28). *The geographies of community disaster resilience*. Global Environmental Change. Retrieved October 26, 2022, from https://www.sciencedirect.com/science/article/abs/pii/S0959378014001459.

Federal Emergency Management Agency. (2020). “Community Resilience Indicator Analysis: County-Level Analysis of Commonly Used Indicators from Peer-Reviewed Research”. Retrieved November 30, 2020, from https://www.fema.gov/sites/default/files/2020-11/fema_community-resilience-indicator-analysis.pdf.

Federal Emergency Management Agency. (2022, September). “Community Resilience Indicator Analysis: Commonly Used Indicators from Peer-Reviewed Research: Updated for Research Published 2003-2021”. Retrieved October 04, 2022, from https://www.fema.gov/sites/default/files/documents/fema_2022-community-resilience-indicator-analysis.pdf.

Fitzpatrick, T. (2016, March 04). “Community Disaster Resilience”. *Disasters and Public Health: Planning and Response,* Second edition, 57-85. Retrieved March 07, 2021, from https://www.sciencedirect.com/science/article/pii/B9780128019801000039#!.

Flanagan, B. E., Gregory, E. W., Hallisey, E. J., Heitgerd, J. L., & Lewis, B. (2011). A Social Vulnerability Index for Disaster Management. Journal of Homeland Security and Emergency Management, 8(1), 1–22. https://doi.org/10.2202/1547-7355.1792.

Given, L. (2012, December 27). "Comparative Analysis". The SAGE Encyclopedia of Qualitative Research Methods. doi: http://dx.doi.org/10.4135/9781412963909.n54.

Grubbs, S. & Wright, B. (2020, October) "Uninsured Texans". Texas Comptroller of Public Accounts. Retrieved May 04, 2021, from https://comptroller.texas.gov/economy/fiscal-notes/2020/oct/uninsured.php.

Gundlach, J. (2016, July 21). "Community Resilience Indicators: Developing New Standards". Sabin Center for Climate Change Law at Columbia Law School. Retrieved December 01, 2020 from http://blogs.law.columbia.edu/climatechange/2016/07/21/community-resilience-indicators-developing-new-standards/.

Lineman, M., Do, Y., Kim, J., & Joo, G.J. (2015, September 29). "Talking about Climate Change and Global Warming". PLoS One, 10(9). doi: 10.1371/journal.pone.0138996.

Mendelsohn, R., Emanuel, K., Chonabayashi, S., & Bakkensen, L. (2012). The impact of climate change on global tropical cyclone damage. Nature Climate Change, 2(3), 205-209. doi:10.1038/nclimate1357.

NOAA Geophysical Fluid Dynamics Laboratory. (2021, March 29). "Global Warming and Hurricanes". Retrieved October 24, 2022, from https://www.gfdl.noaa.gov/global warming-and-hurricanes/.

Nueces County Texas Multi-Jurisdictional Hazard Mitigation Action Plan. Nueces County Texas. (2017, July 25). Retrieved October 25, 2022, from

https://destinyhosted.com/nuecedocs/2017/CC-REG/20170809_365/8660_Hazard%20Mitigation%20Plan.pdf.

Parsons, M., Reeve, I., McGregor, J., Hastings, P., Marshall, G. R., McNeill, J., Stayner, R., & Glavac, S. (2021, June 27). Disaster resilience in Australia: A geographic assessment using an index of coping and Adaptive Capacity. International Journal of Disaster Risk Reduction. Retrieved October 26, 2022, from https://www.sciencedirect.com/science/article/pii/S2212420921003836.

Peacock, W. G. (2010, August). Advancing the Resilience of Coastal Localities: Developing, Implementing and Sustaining the Use of Coastal Resilience Indicators: A Final Report. ResearchGate. Retrieved October 26, 2022, from https://www.researchgate.net/profile/Walter-Peacock/publication/254862206_Final_Report_Advancing_the_Resilience_of_Coastal_Localities_10-02R/links/00b7d51feb3e3d0d4a000000/Final-Report-Advancing-the-Resilience-of-Coastal-Localities-10-02R.pdf.

Perfrement, T., & Lloyd, T. (2015). The Composite Resilience Index: The Modeling Tool to Measure and Improve Community Resilience to Natural Hazards. The Resilience Index. Retrieved October 26, 2022, from https://theresilienceindex.weebly.com/our-solution.html.

Ponto, J. (2015). Understanding and evaluating survey research. Journal of the Advanced Practitioner in Oncology, 6(2), 168–171. https://doi.org/10.6004/jadpro.2015.6.2.9.

“Quickfacts: Nueces County, TX”. In American Community Survey 5-year Estimates: 2019. Data Set: American Community Survey, 2019. Available at data.census.gov (Census Bureau); Accessed: 10/24/22.

"Quickfacts: Refugio County, TX". In American Community Survey 5-year Estimates: 2019. Data Set: American Community Survey, 2019. Available at data.census.gov (Census Bureau); Accessed: 10/24/22.

"Quickfacts: San Patricio County, TX". In American Community Survey 5-year Estimates: 2019. Data Set: American Community Survey, 2019. Available at data.census.gov (Census Bureau); Accessed: 10/24/22.

"Quickfacts: Nueces County, TX". In Population Estimates Program: 2019. Data Set: U.S. Census Bureau Population Estimates Program: 2019. Available at data.census.gov (Census Bureau); Accessed: 10/24/22.

"Quickfacts: Refugio County, TX". In Population Estimates Program: 2019. Data Set: U.S. Census Bureau Population Estimates Program: 2019. Available at data.census.gov (Census Bureau); Accessed: 10/24/22.

"Quickfacts: San Patricio County, TX". In Population Estimates Program: 2019. Data Set: U.S. Census Bureau Population Estimates Program: 2019. Available at data.census.gov (Census Bureau); Accessed: 10/24/22.

"Quickfacts: Texas". In American Community Survey 5-year Estimates: 2019. Data Set: American Community Survey, 2019. Available at data.census.gov (Census Bureau); Accessed: 10/24/22.

Refugio County Multi-Hazard Mitigation Plan 2022. Refugio County Texas. (2022). Retrieved October 25, 2022, from https://www.co.refugio.tx.us/#:~:text=2022%20Refugio%20County%20Multi%2DHazard%20Mitigation%20Plan.

Shah, R. (2019, October). *Transforming Systems in Times of Adversity: Education and Resilience*. U.S. Agency for International Development: Office of Education. Retrieved October 26, 2022, from https://www.eccnetwork.net/sites/default/files/media/file/Resilience%20White%20Paper%20Policy%20Brief_Final.pdf.

Sherrieb, K., Norris, F. H., & Galea, S. (2010). Measuring Capacities for Community Resilience. *Social Indicators Research*, *99*(2), 227–247. https://doi.org/10.1007/s11205-010-9576-9.

Spielman, S., Folch, D., & Nagle, N. (2014). "Patterns and causes of uncertainty in the American Community Survey". *Applied geography, 46*, 147-157. doi:10.1016/j.apgeog.2013.11.002.

The National Academies of Sciences, Engineering, and Medicine. (2019, March 20). "Building and Measuring Community Resilience: Actions for Communities and the Gulf Research Program". Retrieved October 24, 2022, from https://www.ncbi.nlm.nih.gov/books/NBK540795/.

Winderl, T. (2014, February). *Disaster Resilience Measurements: Stocktaking of Ongoing Efforts in Developing Systems for Measuring Resilience*. Retrieved October 26, 2022, from https://www.preventionweb.net/files/37916_disasterresiliencemeasurementsundpt.pdf.

APPENDIX A

METHODOLOGY CORE INDICATOR SUMMARY TABLES

Methodology	Indicator	Type of Indicator	Nueces County	San Patricio County	Refugio County	Communities
Austrailian National Disaster Resilience Index (ANDRI)	Educational Attainment (lack of HS diploma)	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Unemployment Rate	Population-focused	Yes	Yes	Yes	Yes
	Disability	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Limited English Language Proficiency	Population-focused	Yes	Yes	Yes	No
	Home Ownership	Population-focused	Yes	Yes	Yes	Yes
	Mobility (Lack of Vehicle)	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Age 65 and older	Population-focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)
	Household Income (Only Median)	Population-focused	Yes	Yes	No	Yes (no for small communities)
	Single-Parent Households	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Hospital Capacity	Community-Focused	Yes	No	No	No
	Medical Professional Capacity	Community-Focused	Yes	Yes	Yes	Yes (no for small communities)
	Presence of Mobile Homes	Community-Focused	Yes	Yes	Not currently (data from 2018)	No
	Population Change	Community-Focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)

Table 5: Australian National Disaster Resilience Index (ANDRI) Core Indicators Table

Baseline Resilience Indicators for Communities (BRIC)	Educational Attainment (lack of HS diploma)	Population-focused	Yes	Yes	Yes	Yes
	Unemployment Rate	Population-focused	Yes	Yes	Yes	Yes
	Disability	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Limited English Language Proficiency	Population-focused	Yes	Yes	Yes	No
	Home Ownership	Population-focused	Yes	Yes	Yes	Yes
	Mobility (Lack of Vehicle)	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Age 65 and older	Population-focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)
	Income Inequality	Population-focused	Yes	Yes	Yes	Yes
	Lack of Health Insurance	Population-focused	Yes	Yes	Yes	Yes
	Connection to Civil and Social Organizations	Community-Focused	Yes	Yes	No	No
	Hospital Capacity	Community-Focused	Yes	No	No	No
	Medical Professional Capacity	Community-Focused	Yes	Yes	Yes	Yes (no for small communities)
	Affiliation with a Religion	Community-Focused	Not currently (data from 2010 study)	Not currently (data from 2010 study)	Not currently (data from 2018)	No
	Presence of Mobile Homes	Community-Focused	Yes	Yes	Not currently (data from 2018)	No
	Public School Capacity	Community-Focused	No	No	No	No
	Population Change	Community-Focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)
	Hotel/Motel Capacity	Community-Focused	Yes	Yes	Not currently (data from 2016)	No
	Rental Property Capacity	Community-Focused	Yes	Yes	Yes	Yes for major communities

Table 6: Baseline Resilience Indicators for Communities (BRIC) Core Indicators Table

Community Disaster Resilience Index (CDRI)	Educational Attainment (lack of HS diploma)	Population-focused	Yes	Yes	Yes	Yes
	Unemployment Rate	Population-focused	Yes	Yes	Yes	Yes
	Limited English Language Proficiency	Population-focused	Yes	Yes	Yes	No
	Home Ownership	Population-focused	Yes	Yes	Yes	Yes
	Mobility (Lack of Vehicle)	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Household Income (Only Median)	Population-focused	Yes	Yes	No	Yes (no for small communities)
	Lack of Health Insurance	Population-focused	Yes	Yes	Yes	Yes
	Connection to Civil and Social Organizations	Community-Focused	Yes	Yes	No	No
	Hospital Capacity	Community-Focused	Yes	No	No	No
	Medical Professional Capacity	Community-Focused	Yes	Yes	Yes	Yes (no for small communities)
	Affiliation with a Religion	Community-Focused	Not currently (data from 2010 study)	Not currently (data from 2010 study)	Not currently (data from 2018)	No
	Public School Capacity	Community-Focused	No	No	No	No
	Hotel/Motel Capacity	Community-Focused	Yes	Yes	Not currently (data from 2016)	No
	Rental Property Capacity	Community-Focused	Yes	Yes	Yes	Yes for major communities

Table 7: Community Disaster Resilience Index (CDRI) Core Indicators Table

Community Resilience Index (CRI)	Educational Attainment (lack of HS diploma)	Population-focused	Yes	Yes	Yes	Yes
	Unemployment Rate	Population-focused	Yes	Yes	Yes	Yes
	Household Income (Only Median)	Population-focused	Yes	Yes	No	Yes (no for small communities)
	Income Inequality	Population-focused	Yes	Yes	Yes	Yes
	Single-Parent Households	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Connection to Civil and Social Organizations	Community-Focused	Yes	Yes	No	No
	Medical Professional Capacity	Community-Focused	Yes	Yes	Yes	Yes (no for small communities)
	Affiliation with a Religion	Community-Focused	Not currently (data from 2010 study)	Not currently (data from 2010 study)	Not currently (data from 2018)	No
	Population Change	Community-Focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)

Table 8: Community Resilience Index (CRI) Core Indicators Table

Disaster Resilience of Place (DROP)	Educational Attainment (lack of HS diploma)	Population-focused	Yes	Yes	Yes	Yes
	Unemployment Rate	Population-focused	Yes	Yes	Yes	Yes
	Disability	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Limited English Language Proficiency	Population-focused	Yes	Yes	Yes	No
	Home Ownership	Population-focused	Yes	Yes	Yes	Yes
	Mobility (Lack of Vehicle)	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Age 65 and older	Population-focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)
	Income Inequality	Population-focused	Yes	Yes	Yes	Yes
	Lack of Health Insurance	Population-focused	Yes	Yes	Yes	Yes
	Connection to Civil and Social Organizations	Community-Focused	Yes	Yes	No	No
	Hospital Capacity	Community-Focused	Yes	No	No	No
	Medical Professional Capacity	Community-Focused	Yes	Yes	Yes	Yes (no for small communities)
	Affiliation with a Religion	Community-Focused	Not currently (data from 2010 study)	Not currently (data from 2010 study)	Not currently (data from 2018)	No
	Presence of Mobile Homes	Community-Focused	Yes	Yes	Not currently (data from 2018)	No
	Public School Capacity	Community-Focused	No	No	No	No
	Rental Property Capacity	Community-Focused	Yes	Yes	Yes	Yes for major communities

Table 9: Disaster Resilience of Place (DROP) Core Indicators Table

Resilient Capacity Index (RCI)	Educational Attainment (lack of HS diploma)	Population-focused	Yes	Yes	Yes	Yes
	Disability	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Home Ownership	Population-focused	Yes	Yes	Yes	Yes
	Income Inequality	Population-focused	Yes	Yes	Yes	Yes
	Lack of Health Insurance	Population-focused	Yes	Yes	Yes	Yes
	Connection to Civil and Social Organizations	Community-Focused	Yes	Yes	No	No
	Population Change	Community-Focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)
	Hotel/Motel Capacity	Community-Focused	Yes	Yes	Not currently (data from 2016)	No

Table 10: Resilient Capacity Index (RCI) Core Indicators Table

Social Vulnerability Index (SoVI)	Educational Attainment (lack of HS diploma)	Population-focused	Yes	Yes	Yes	Yes
	Unemployment Rate	Population-focused	Yes	Yes	Yes	Yes
	Disability	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Limited English Language Proficiency	Population-focused	Yes	Yes	Yes	No
	Mobility (Lack of Vehicle)	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Age 65 and older	Population-focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)
	Household Income (Only Median)	Population-focused	Yes	Yes	No	Yes (no for small communities)
	Single-Parent Households	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Presence of Mobile Homes	Community-Focused	Yes	Yes	Not currently (data from 2018)	No

Table 11: Social Vulnerability Index (SVI) Core Indicators Table

The Composite Resilience Index (TCRI)	Unemployment Rate	Population-focused	Yes	Yes	Yes	Yes
	Disability	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Limited English Language Proficiency	Population-focused	Yes	Yes	Yes	No
	Home Ownership	Population-focused	Yes	Yes	Yes	Yes
	Mobility (Lack of Vehicle)	Population-focused	Yes	Yes	Yes	Yes (no for small communities)
	Age 65 and older	Population-focused	Yes	Yes	Yes	Yes (no for unincorporated municipalities)
	Household Income (Only Median)	Population-focused	Yes	Yes	No	Yes (no for small communities)
	Connection to Civil and Social Organizations	Community-Focused	Yes	Yes	No	No
	Hospital Capacity	Community-Focused	Yes	No	No	No
	Public School Capacity	Community-Focused	No	No	No	No

Table 12: The Composite Resilience Index (TCRI) Core Indicators Table

APPENDIX B

GENERAL PUBLIC SURVEY QUESTIONNAIRE

Personal Questions:

Please note the community you reside in:

Please note the type of area you reside in (Urban, Suburban, Small Town, Rural):

If you are interested in obtaining a gift card for your participation, please provide your email address:

Research Questions:

1. How long have you been a resident in your community?
    - 0-6 months
    - 6 months - 1 year
    - 2-5 years
    - 5-10 years
    - Over 10 years

Every community faces hazards that may cause disruption to normal life. The next two questions list 19 natural and/or man-made hazards that some communities may face at one time. In the first question, you are asked to rate your level of concern regarding each hazard in your community. The second question will ask you to rate the level of disruption you believe would occur should such an event happen within your community. Please be sure to rate each hazard in both questions. For example, you may be "not concerned" about the threat of a nuclear explosion in your community, but if a nuclear explosion happened in your community it would cause "high community disruption."

2. The following is a list of natural and man-made hazards that could occur in your community. Using the list, please rate your concern about each hazard occurring in your community.

	Unsure	Not concerned	Minor concern	Moderate concern	High concern
Active shooter	○	○	○	○	○
Bomb threat/explosion	○	○	○	○	○
Brushfire/wildfire	○	○	○	○	○
Cyberattack	○	○	○	○	○
Drought	○	○	○	○	○
Earthquake	○	○	○	○	○
Erosion	○	○	○	○	○
Extended power outage	○	○	○	○	○
Extreme cold	○	○	○	○	○
Extreme heat	○	○	○	○	○
Flood	○	○	○	○	○
Hurricane	○	○	○	○	○
Industrial hazardous materials release/explosion	○	○	○	○	○
Pandemic	○	○	○	○	○
Political insurrection	○	○	○	○	○
Storm surge/coastal inundation	○	○	○	○	○
Terrorism	○	○	○	○	○
Thunderstorms/lightning	○	○	○	○	○
Tornado	○	○	○	○	○

3. Using the same list of hazards provided, please rate your estimation of the level of disruption each hazard would cause should it occur in your community.

	Unsure	No community disruption	Minor community disruption	Moderate community disruption	High community disruption
Active shooter	○	○	○	○	○
Bomb threat/explosion	○	○	○	○	○
Brushfire/wildfire	○	○	○	○	○
Cyberattack	○	○	○	○	○
Drought	○	○	○	○	○
Earthquake	○	○	○	○	○
Erosion	○	○	○	○	○
Extended power outage	○	○	○	○	○
Extreme cold	○	○	○	○	○
Extreme heat	○	○	○	○	○
Flood	○	○	○	○	○
Hurricane	○	○	○	○	○
Industrial hazardous materials release/explosion	○	○	○	○	○
Pandemic	○	○	○	○	○
Political insurrection	○	○	○	○	○
Storm surge/coastal inundation	○	○	○	○	○
Terrorism	○	○	○	○	○
Thunderstorms/lightning	○	○	○	○	○
Tornado	○	○	○	○	○

4(a). Is English your first or second speaking language?

- First
- Second

4(b). On a scale of 1 (Not confident) to 5 (Very confident), please rate your level of confidence in your ability to speak English.

	Not confident	A little confident	Confident		Very Confident
	1	2	3	4	5
English Language Competency					

5. Members of religious organizations can access additional support beyond their family and neighbors. Would you consider yourself a member of a religious organization?

- Yes
- No
- Not sure

6(a). On a scale from 1 (inactive) to 5 (very active), please rate your level of engagement with your local government.

	Inactive	A little active	Somewhat active	Active	Very Active
	1	2	3	4	5
Level of Engagement					

6(b). If your answer is below a 3 on the scale provided above, please explain why and how this could be improved.

7(a). The following is a list of income ranges. From the choices below, please rate your current income level.

- $20,000 and below
- $20,000-$49,999
- $50,000-$99,999
- $100,000-$149,999
- $150,000 and above

7(b). Based on your answer above, do you have the financial standing to prepare and withstand a disaster? For example, saving a year's worth of expenses in an emergency fund will put you in good shape to deal with the damages associated with a potential disaster event.

- ○ Yes
- ○ No
- ○ Not sure

8. The following is a list of resources most households have or have access to. Using the table provided, please rate your level of access to these resources.

	Yes	Yes, but not stable access	No
Electricity	○	○	○
Drinkable Water	○	○	○
Gas	○	○	○
Air conditioning	○	○	○
Internet	○	○	○
Cell service	○	○	○
Health services	○	○	○
Public school	○	○	○
Latrines or toilets	○	○	○
Public parks	○	○	○
Financial assistance	○	○	○
Roadways	○	○	○
Civic and social organizations	○	○	○

9. Availability and access to physicians are a critical emergency resource in the response to and recovery from a disaster. How far away is a hospital or medical clinic from your household? (in minutes)

10. Public schools represent a community's ability to provide safe shelter for individuals and help evacuations. To the best of your knowledge, how far away is the nearest public school from your household? (in minutes)

11. A mobile home is defined as a movable or portable home connected to utilities, without a permanent foundation. Do you reside in a mobile home?

- Yes
- No

12. Hotels and motels can provide housing to individuals who must leave their homes, either to find safe shelter from the disaster or as temporary housing during recovery. Do you consider there to be a good amount of hotels and motels in the area, or not enough?

- A good amount
- Not enough
- Not sure

13. Examples of civic/social organizations include nonprofit social clubs, alumni organizations, societies, and associations. Participation in civic and social organizations increases networking and trusted relationships in a community. Do you participate or volunteer in any group activities provided by a civic and/or social organization?

- Yes
- No
- Not sure

14. If you said yes to the question above, please rate your level of involvement in civic and social organizations using the scale from 1 (Not involved) to 5 (Very involved).

	Not involved	A little involved	I am involved	Very involved
	1	2	4	5
Participation in Civic & Social Organizations				

15. Is there anything else you would like to note that impacts your ability to withstand a disaster?

APPENDIX C

PUBLIC OFFICIALS & STAKEHOLDERS SURVEY QUESTIONNAIRE

Personal Questions:

Please provide your organization:

Please note the community you represent in your official role:

Please note the type of area you reside in (Urban, Suburban, Small Town, Rural):

Research Questions:

1. How long have you been working in an official capacity in your community?

2. Are you and/or your organization familiar with the concept of community resilience and the different methods of community resilience assessment?

- Yes
- No
- Somewhat

3. Does your community have the ability to conduct an assessment of its resilience to natural and/or man-made disasters?

- Yes
- No
- Somewhat
- Not sure

4. The spatial resolution of most community resilience assessment tools is at the county level. Would your community's resilience be improved if a methodology to determine the most appropriate resilience assessment tool was available at a sub-county level? If yes, please explain why.

- Yes _____
- No
- Maybe

5. Even though the data primarily used in resilience assessment methodologies is at the county or census tract level, do you believe this approach can be adapted to rural, small, and underserved communities? If no, please explain why.

- Yes
- No _____
- Maybe

6. Using the scale below, please rate the level of public engagement with your organization in disaster response, recovery, and/or mitigation.

	No Engagement	Little Engagement	Some Engagement	Significant Engagement	
	1	2	3	4	5
Public Engagement Level					

7(a). On the scale below, please rate the level of difficulty in obtaining community engagement in disaster response and recovery.

	Extremely Difficult	Very Difficult	Somewhat Difficult	Not Difficult	
	0	25	50	75	100
Community Engagement					

7(b). Why do you think it is difficult?

8. A key aspect of assessing resilience in a community is trust. The following is a list of pre-stressors that could impede communication between local government and the public by decreasing the level of mutual trust in the community. Are any of the following significant issues in your community?

	Yes	No	Not sure
Burglaries	○	○	○
Robberies/assaults	○	○	○
Gangs	○	○	○
Vandalism	○	○	○
Violent disputes	○	○	○
Alcohol abuse	○	○	○
Substance (drug) abuse	○	○	○
Teen Pregnancy	○	○	○
Domestic violence	○	○	○
Child abuse	○	○	○
Prostitution	○	○	○
Other problems	○	○	○

9. In the last five years, the overall quality of life of the people living in your community has: (consider job availability, safety and security, environment, housing, etc.)

- Improved
- Worsened
- Remained the same

10. Thinking about 'holistic' resilience assessment, do you think it is possible to consider all shocks and stressors (acute, chronic, anthropogenic, and natural) when measuring community resilience at the local level?

- Yes
- No
- Maybe

11. The following is a list of indicators used in community resilience assessment tools. On a scale of 1 (Not Difficult) to 5 (Extremely Difficult), please rate the level of difficulty in obtaining this information from your community.

	Not Difficult 1	A Little Difficult 2	Difficult 3	Very Difficult 4	Extremely Difficult 5
Limited English Language Proficiency					
Ratio of large to small businesses in the area					
Hospital Capacity					
Public School Capacity					
Presence of Mobile Homes					
Hotel/Motel Capacity					
Connection to Civic & Social Organizations					
Affiliation with Religion					
Single Sector Employment Dependence					
Flood Insurance Coverage					
Voter Participation in the Latest Election					
Percent of the population covered by a recent hazard mitigation plan					
Percent of the population participating in the Community Rating System for Flood (CRS)					
Corporate Tax Avenues					
Medical Professional Capacity					

12. Based on your answer above, which indicators listed require public input? If it is difficult to obtain this local date, please briefly explain why.

13. Which sources of information do you use to engage the public in disaster response, recovery, and/or mitigation?

- [ ] Newspapers
- [ ] Social Media Platforms (Instagram, Facebook, Twitter, etc.)
- [ ] Television Broadcasting
- [ ] Word of Mouth (Through Organizations, Press Conferences)
- [ ] Magazines
- [ ] Public Council / Government Meetings
- [ ] Government Documents
- [ ] Other _____

14. Based on the question above, have you noticed which sources of information most people in your community pay attention to? If yes, what are their trusted sources of information?

- Yes _____
- No
- Not Sure

15. Does you consider your community to have a diverse business environment?

- Yes
- No
- Not sure

16. What fraction of your community is accessible by car during a storm?

- The entire community
- Most of the community
- About half the community
- Less than half / very few
- No one in the community

17. Does your community have access to a health clinic or hospital?

- Yes
- No

18. If yes, does the health clinic or hospital have sufficient:

	Sufficient	Insufficient	None / no health facility
Basic medicines	○	○	○
Equipment/instruments	○	○	○
Patient beds	○	○	○
Ambulances	○	○	○
Physicians	○	○	○
Nurses	○	○	○
Other health staff	○	○	○

19. Mental health support is an indicator in community resilience because it speaks to the level of life satisfaction in your community. Are there any mental health support facilities available in your area?

- Yes
- No
- Not Sure

20. A community's water supply is an important indicator in community resilience because it reports the level of access your citizens have to a critical resource. To the best of your knowledge, your community's water supply is:

- Sufficient
- Insufficient
- Not sure

21. What part of your community is covered by an NFIP (National Flood Insurance Program) policy?

- The entire community
- Most of the community
- About half of the community
- Less than half / very few
- No one in the community
- Not sure

22. What part of your community is participating in the Community Rating System for Flood (CRS)?

- The entire community
- Most of the community
- About half of the community
- Less than half / very few
- No one in the community
- Not sure

23. Is there anything else of concern related to your community's ability to assess its resilience?

May we contact you for more information? If so, please leave a good contact number or email.

- ○ Yes _____
- ○ Maybe
- ○ Not at this time

APPENDIX D

FOCUS GROUP QUESTIONNAIRE

1. Have you resided in your community for more or less than five years?

2. What are your general feelings about your local government? Are you confident sharing your general opinion and needs with public officials?
    a. Do you feel your needs will be met?

3. In the past, have you had any difficulty accessing government services and resources in times of crisis?

4. Individual resilience is important for community resilience because healthy, socially connected, prepared people make for stronger communities able to withstand disaster risk. Do you feel adequately prepared for future natural or man-made disaster events?

5. Are you familiar with the location of safe shelters in your community?
    a. If not, what are your thoughts on access to emergency information from your local government?

6. Is there an evacuation route close by to your residence?

7. Did you vote for a candidate in the recent local, state, and/or federal elections?

8. In your free time, do you participate in volunteer work in your community?

9. Access to medical care and professionals are important in times of crisis. Do you feel there is sufficient access and availability of medical resources in your community?
    a. Access to adequate care
    b. Access to mental health services
    c. Physician availability

10. Do you consider your community to have more small, local businesses?

11. Do you feel safe walking in your neighborhood?
    a. If not, please explain why.

12. What are specific issues, concerns, or problems you've faced after a natural disaster event in your community? How significant is the problem or concern you have?