Socio-Behavioral-Economic Observing System Indicators for Coastal Community Sustainability

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EXECUTIVE SUMMARY

A critical element to effective disaster response is an understanding of the underlying social-behavioral-economic (SBE) conditions of the impacted community. Identifying SBE indicators that can be used in disaster response assessments, as well as day-to-day decision-making, is important for resource deployment as well as resiliency and adaptation strategies. The overarching goal of this work is to create a Socio-Economic Observing System (SEOS) that includes collection of SBE data and information which demonstrate the link between environmental change and human well-being.

The project goal was to develop a list of stakeholder-relevant, expert-vetted SBE indicators that have a high likelihood for implementation and a protocol for collecting and monitoring data that represents those indicators. An iterative stakeholder engagement process was used to gather data and information to support this project goal. To gather stakeholder feedback, researchers conducted in person meetings and workshops, hosted webinars, attended resource manager meetings, and collected survey feedback. All data and information collected from stakeholders was incorporated into a searchable database.

Two lists of highly relevant SBE indicators were developed as a result of the stakeholder engagement process. One list was ranked by resource managers and the other was ranked by SBE indicator practitioners. A major finding was that, in general, the indicator practitioners and resource managers agreed on which indicators should be on the prioritized list. A criteria assessment was conducted for the ranked indicators based on ease of implementation, transferability, data availability, and applicability.

The results of this research will inform future research endeavors, including operationalizing SEOS within the National Estuarine Research Reserves in the Gulf of Mexico and beyond.

INTRODUCTION

The overarching goal of this work is to create a Socio-Economic Observing System (SEOS) that includes collection of social-behavioral-economic (SBE) metrics which demonstrate the link between environmental change and human well-being. Overarching objectives include the implementation of SEOS in Gulf of Mexico at the National Estuarine Research Reserves (NERRS) in the short-term, at all NERRS in the United States in the medium-term, and the expansion of SEOS to National Estuary Programs and to National Oceanic and Atmospheric Administration's (NOAA's) Sentinel Sites in the long-term.

The project goal was to develop a list of stakeholder-relevant, expert-vetted socio-economic indicators that have a high likelihood for implementation and a protocol for collecting and monitoring data that represents those indicators. Project objectives

were to: 1) inventory the state-of-art SBE indicators for community and human well-being by bringing together leading expertise in this area to populate a searchable database, 2) examine operationalizing the indicators in a local context by working with Gulf of Mexico NERRS, and 3) publish online and in print a guide to socio-economic indicators for disaster response and community resilience (Appendix 5).

PROJECT IMPLEMENTATION

This project incorporated stakeholder perspectives and interests through several avenues, including: hosting a Gulf of Mexico NERRS manager meeting, attending the 2017 NERRS annual meeting, and conducting a series of workshops and webinars (Figure 1). A list of the participants has been compiled (Appendix 1). Each project phase is elaborated on in the following sections.
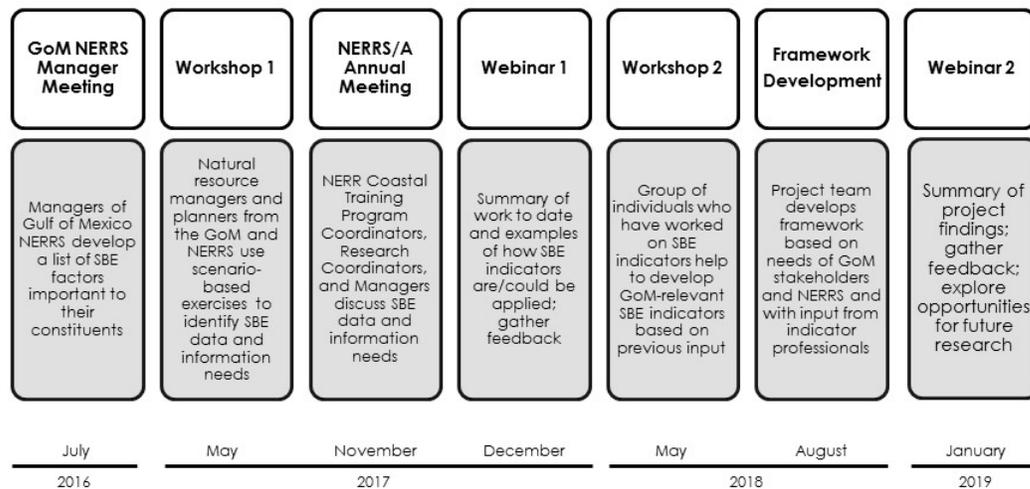
Figure 1. Project timeline.

Gulf of Mexico NERRS Manager Meeting

A meeting with the NERRS managers in the Gulf of Mexico was held in July 2016 in Apalachicola, Florida. At the meeting, managers in attendance began to explore the types of SBE data and information they need to make effective management decisions. Workshop participants included representatives from Apalachicola NERR, Rookery

Bay NERR, Grand Bay NERR, Weeks Bay NERR, and Mission-Aransas NERR. A list of the types of information needed was compiled (Appendix 2).

Workshop 1
The goal of the first workshop was to 1) create and enhance awareness of SBE metrics and tools, 2) identify short- and long-term SBE data and information needs for coastal stewardship, 3) identify opportunities for leveraging collaboration, and 4) gather feedback on possibilities for implementation, including potential pilot projects. Objectives for workshop participants were for participants to 1) gain a better understanding of SBE indicators and their application, 2) help identify the SBE dimensions that would lead to more effective management of our coastal resources, 3) identify opportunities for implementing SBE indicators in their own work, and 4) identify short- and long-term information needs in the Gulf of Mexico. Objectives also included identifying opportunities for leveraging collaboration and creating and enhancing awareness of SBE metrics and tools among workshop participants.

The first workshop was organized, hosted and reported out over a one-year period (Figure 2). To prepare for the workshop, a one-pager was developed and sent to potential participants to stimulate interest. Once participants were identified and confirmed, a survey was sent out to determine 1) if and how SBE data and information have been incorporated into participants' current work and the management plans that guide their work, 2) the type of SBE data and information they need to make decisions and/or carry out their work, and 3) relevant stakeholders. Results of this survey were compiled, summarized, and presented at the workshop (Appendix 3).

The workshop was hosted at the Harte Research Institute in Corpus Christi, Texas in May 2017. Workshop participants included representatives from NOAA's National Ocean Service and Office for Coastal Management, NERRS (i.e. Lake Superior, Grand Bay, Mission-Aransas, Weeks Bay, Apalachicola), Northern Gulf of Mexico Sentinel Site Cooperative, Coastal Bend Bays and Estuary Program, Galveston Bay Estuary Program, City of Rockport, Texas Sea Grant, Texas A&M University- Corpus Christi, and the Tampa Bay Estuary Program.

The workshop began with a presentation on SBE indicators (what they are and why they are valuable in research and decision-making). This presentation led to a discussion on the programmatic priorities and management needs of participants. Participants were also presented with current SBE tools, such as Digital Coast and Economics: National Ocean Watch. The rest of the workshop was spent in two group exercises.

The first group exercise was conducted to 1) identify SBE information needs and 2) familiarize participants with incorporating SBE information into decision-making in the context of specific scenarios (i.e. potential restoration or development project, program justification or funding request, or program assessment). After participants identified SBE needs, participants identified stakeholders, potential issues and

concerns, and measures of SBE information that could be used within the context of each scenario.

One Pager Developed	Potential Attendees Identified	Survey	Workshop Hosted	Data Compilation and Analysis	Webinar
One pager developed to send to potential attendees and promote workshop	Natural resource managers and planners from the GoM and NERRS invited to attend workshop	Survey developed and administered to determine if and how SBE indicators have been incorporated into attendees management plans	Natural resource managers and planners from the GoM and NERRS use scenario-based exercises to identify SBE data and information needs	SEG compiles data collected at workshop and meetings and compares results across stakeholder groups	Webinar hosted to report out on data and information collected at workshop and previous meetings and gather feedback from stakeholders
January-February	February-March	April-May	May	May-November	December

2017

Figure 2. Workshop 1 timeline.

The second group exercise focused on how to integrate SBE information into the adaptive management process by considering the use of SBE data and information at various steps in management processes and how that data could help inform management decisions. The participants considered the wants, needs and perspectives of stakeholders discussed in the first group exercise and identified SBE data and information needs associated with each step of the adaptive management cycle. Prioritization of SBE data and information was also discussed in the context of having to make management decisions with limited resources.

The workshop concluded with a discussion on the opportunities and challenges associated with implementing SBE information into decision-making. Data generated at the workshop was incorporated into the database.

NERRS Annual Meeting
Project team members attended the NERRS Annual meeting in November 2017. At the meeting, project team lead Dr. David Yoskowitz met with the NERRS managers to brainstorm on the types of SBE data and information that would be most useful to resource management and decision-making in their region (i.e. Southeast and Caribbean, Mid-Atlantic, Great Lakes, Gulf of Mexico, Northeast, West Coast and Pacific). Dr. Yoskowitz also met with the NERRS Research and Coastal Training Program Coordinators to determine the types of SBE data and information they need. Feedback generated from these meetings was compiled into a document (Appendix 4) and incorporated into the database.

Webinar 1

A webinar was hosted to report findings to Workshop 1 participants and gather feedback on the information generated and potential pathways forward. On the webinar, a summary of the work to date, including output from Workshop 1, were presented. Examples of how SBE indicators have been and could be applied were also presented. One output discussed during the webinar included a list of the combined outputs from the Gulf of Mexico NERRS manager meeting and Workshop 1, which highlighted common SBE information and data needs (Figure 3). Webinar participants were also provided with ways to incorporate SBE data and information into their own work and examples were used to show how SBE indicators have been used by the Puget Sound Partnership (Biedenweg et al., 2014).

Figure 3. Overarching themes and categories of SBE data and information needs of Gulf of Mexico NERRS Managers and Workshop 1 participants. The bolded themes

and categories were outputs from both the Gulf of Mexico NERRS Managers meeting and from Workshop 1.

Workshop 2

The goal of Workshop 2 was to develop a prioritized list of Gulf of Mexico SBE indicators that have a high likelihood of implementation and can be used by resource managers to assess the impacts of environmental stressors and disasters on coastal community well-being and resilience. Workshop 2 objectives were to 1) understand SBE data and information needs articulated at previous meetings, 2) review and select SBE indicators that help meet management needs, are easily explained, justified and can be connected to bio-geo-physical monitoring and processes, 3) describe data needed for SBE indicators, 4) determine if data for indicators is available, and if so, from where, and 5) assess indicators based on criteria (including data availability, ease of implementation, and transferability). Data generated at the workshop were incorporated into the database.

Workshop 2 was held over a day and half and was attended by individuals who represented SBE indicator practitioners or resource managers. Workshop participants included representatives from NOAA's National Marine Fisheries Service and Office for Coastal Management, NIST, EPA, NERRS (i.e. Rookery Bay, Grand Bay, Mission-Aransas, Apalachicola), Northern Gulf of Mexico Sentinel Site Cooperative, Coastal Bend Bays and Estuary Program, and City of Rockport. The workshop began with a presentation on the project's background so that attendees understood the goals and objectives for the overall project. This overview was followed by a review of SBE data and information needs that were provided by participants at the first workshop, along with input from resource managers and community members from previous meetings around the Gulf of Mexico. Participants were encouraged to share their perspectives of and experience with SBE data and information at this point.

The rest of day one of the workshop was spent in group exercises. Participants were split into four groups with an attempt for even distribution of resource managers and indicator practitioners in each group. Attendees spent approximately one hour in each of the four breakout groups. All data gathered prior to the workshop were aggregated into four focal themes by the project team. Focal themes were resilience, communities, well-being, and the human-environment connection (i.e. ecosystem services).

The task for each breakout group was to select SBE indicators that meet identified needs and can be operationalized. Participants were also asked to consider indicators that can be used in adaptive management and strongly connect to bio-geo-physical metrics. After identifying SBE indicators, participants discussed the types of data and information needed for these indicators and assessed data availability. Participants rotated so they were able to provide input on each focal theme and the SBE indicators generated by previous breakout groups.

At the end of the first day, the project team reviewed the list generated for each theme and compiled information into a comprehensive list. Topics on this comprehensive list were assessed for possible duplications or overlap. A revised list was then generated for review by participants at the start of day two of the workshop.

On the second day of the workshop, participants reviewed the compiled list of indicators generated the day prior. As a group, participants were tasked with discussing the list, combining duplicative indicators, and adding additional indicators, if needed. The new list was generated based on participant discussion and consensus. The compiled list began with 58 indicators, which were narrowed down to 32 SBE indicators. The end-product was a refined list of SBE indicators that were then prioritized and ranked by attendees (Table 1).

Table 1. Refined list of SBE indicators complied by participants at Workshop 2.

INDICATOR
Shoreline and habitat Change (ability to provide ecosystem services)
Scientific and educational value, environmental literacy
Stewardship/attitude
Implementation of resilience actions/ activities
Recreational use value
Access- Number of access points (trails, boat ramps, piers/distribution/diversity of activities/private vs. public/managed areas), number of trails, number of boat ramps, maintenance of boat ramps, proximity to water, kayakers
Community connectedness to natural resources (recreational fishing engagement, commercial fishing, community trust)
Dependence on natural resources (economic and social)
Human health
Market Economic Impact - recreation tourism (dependent on natural resources), education, outreach (special events), commercial extracted industries, dependence on farm and wild-harvest marine resources, and local recreation and tourism, visitors of NERRs
Aesthetic value
Existence/passive use
Resilience actions to mitigate flooding and sea level rise
Nuisance flooding impacts
Flood protection value cost and damage avoided
Coastal economic characterization
Diversity of users-equity of services
Environmental justice
Community vulnerability
Property value
Real estate & permanent migration
Degree of naturalness- amount of impervious surfaces, rate of change, ratio of green to grey infrastructure, degree of naturalness/open space/type of open space (diversity)
Shoreline change (ability to provide ecosystem services)
Natural hazards impacts

Resilient attitudes
Sense of place (ties to community & environment)
Population dynamics and community characterization
Cultural value - subsistence fishing (could also be economic), conversion of working waterfront (gentrification), traditional resource use/methods (i.e. net mending), historical & cultural importance
Stewardship actions
Community engagement
Traditional ecological knowledge (TEK)
Connection to natural resources

After the SBE list was refined, participants divided into two groups: resource managers and indicator practitioners. Members of each group ranked each of the 32 SBE indicators as 'high', 'medium' or 'low' based on whether indicators 1) would help meet management needs, 2) are easily explained and justified, and 3) can be connected to bio-geo-physical processes. Once ranking was completed by each individual, each group discussed how each SBE indicator was ranked by members of that group. For each group, a list of the top 20 most highly ranked indicators was compiled (Table 2).

Most of the indicators on the list of top 20 most highly-ranked indictors were the same for both the resource manager and indicator practitioner group. The only difference was that the indicator practitioner list included 1) degree of naturalness, 2) natural hazards impact, and 3) community engagement. The resource manager list included 1) nuisance flooding impacts, 2) flood protection value cost and damage avoided, and 3) stewardship actions. Because the focus on the project was to generate a list of SBE indicators that 1) have a high likelihood for implementation and 2) can be used by resource managers, the list generated by resource managers was chosen for prioritization by all participants (Table 3).

Table 2. List of top 20 most highly-ranked SBE indictors according to the indicator practitioner and resource manager groups.

Indicator practitioners	Resource managers
Market economic impact – local and recreational tourism (dependent on natural resources), education and outreach (special events), commercial industries, dependence on farm and wild-harvest marine resources, visitors of NERRS	Market economic impact – local and recreational tourism (dependent on natural resources), education and outreach (special events), commercial industries, dependence on farm and wild-harvest marine resources, visitors of NERRS
Resilience actions to mitigate flooding and Sea Level Rise	Resilience actions to mitigate flooding and Sea Level Rise
Dependence on natural resources (economic and social)	Dependence on natural resources (economic and social)
Shoreline and habitat change (and ability to provide ecosystem services)	Shoreline and habitat change (and ability to provide ecosystem services)

Implementation of resilience actions and activities	Implementation of resilience actions and activities
Recreational use value	Recreational use value
Access	Access
Environmental justice	Environmental justice
Stewardship / attitude	Stewardship / attitude
Human health	Human health
Scientific and educational value, environmental literacy	Scientific and educational value, environmental literacy
Community vulnerability	Community vulnerability
Cultural value - subsistence fishing, conversion of working waterfront (gentrification), traditional resource use / methods (i.e. net mending), historical and cultural importance	Cultural value - subsistence fishing, conversion of working waterfront (gentrification), traditional resource use / methods (i.e. net mending), historical and cultural importance
Resilient attitudes	Resilient attitudes
Population dynamics and community characterization	Population dynamics and community characterization
Community connectedness to natural resources (recreational fishing engagement, commercial fishing, community trust)	Community connectedness to natural resources (recreational fishing engagement, commercial fishing, community trust)
Sense of place (ties to community and environment)	Sense of place (ties to community and environment)
Degree of naturalness	Nuisance flooding impacts
Natural hazards impacts	Flood protection (value, cost, and damage avoided)
Implementation of resilience actions and activities	Stewardship actions

Table 3. Prioritized list of SBE indicators according to participants at Workshop 2. Ranking questions calculate the average ranking for each answer choice so you can

determine which answer choice was most preferred overall. The answer choice with the largest average ranking is the most preferred choice.

Ranking	Indicator	Percent Average Ranking Score
1	Market economic impact	8.37
2	Dependence on natural resources (economic and social)	8.10
3	Recreational Use Value	6.97
4	Resilience actions to mitigate flooding and Sea Level rise	5.94
5	Scientific and educational value, environmental literacy	5.81
6	Population Dynamics and Community Characterization	5.77
7	Shoreline and Habitat Change (ability to provide ecosystem services)	5.54
8	Community vulnerability	5.53
9	Stewardship/attitude	5.06
10	Access	4.79
11	Community connectedness to natural resources	4.72
12	Flood protection value cost and damage avoided	4.34
13	Nuisance Flooding Impacts	4.10
14	Cultural Value	3.89
15	Human Health	3.87
16	Resilient Attitudes	3.66
17	Environmental Justice	3.56
18	Stewardship Actions	3.52
19	Sense of place (ties to community & environment)	3.32
20	Implementation of resilience actions/ activities	3.15

Criteria Assessment
After Workshop 2, a criteria assessment of the most highly ranked SBE indictors was conducted via email correspondence and implemented using Qualtrics. The survey asked participants to complete a criteria assessment for each indicator using the following criteria: 1) likelihood of implementation, 2) likelihood of transferability, 3) data availability, and 4) applicability. Criteria was ranked on a Likert scale from 1 to 5, with an option for the participant to select the option 'do not know'. The results of the criteria assessment are compiled and analyzed (Appendix 5).

The definitions provided for each criteria were:
- *Likelihood of Implementation*: is based on a minimal amount of effort required for the execution of data collection and/or analysis. Considerations regarding likelihood or ease of implementation include:
  - Cost and effort required for data collection and analysis for non-practitioners (e.g. natural resource managers, etc.)
  - How easy the indicator is understood by the end user (e.g. Reserve staff, etc.).

- *Likelihood of Transferability*: is the degree to which the indicator can be generalized to other settings and/or applications, such as across coastal management, marine protected areas, and monitoring programs
- *Data Availability*: data is readily available to end users or can be acquired with minimal effort/resources.
- *Applicability*: usefulness and relevance. Considerations regarding applicability include:
  - The extent to which the end user understands how the indicator will be used (e.g. for grant writing, economic justification, etc.)
  - An indicator that is vetted and accepted.

Webinar 2

A webinar was held to report research to participants at workshops 1 and 2 and gather feedback on the information generated and potential pathways forward, including how people would like research findings to be made available to them and potential opportunities for future research. On the webinar, a summary of the work to date, including output from Workshop 2, were presented. Clarification on several indicator categories were also discussed. The project team analyzed the final indicators from Workshop 2 and determined that several indicators were similar. On the webinar, the project team confirmed that the participants from Workshop 2 agreed and why the indicator categories ranked differently, such as 2. Stewardship/attitude and 18. Stewardship actions. Webinar participants were also provided criteria assessment results on the three most highly ranked indicators: market economic impact, dependence on natural resources, and recreational use value. This led to a discussion about criteria remaining equally weighted versus varying weights of importance.

SUMMARY OF FINDINGS AND NEXT STEPS
Summary of Findings

Data collected for this project will be incorporated into a database. This data will be used to inform future projects and support the resource management needs in the Gulf of Mexico, including within the Gulf of Mexico NERRS. The prioritized list of SBE indicators (Figure 4) is especially valuable, along with the criteria assessment associated with the SBE indicators on that list (Appendix 5).

Next Steps

With the finalized list of highly ranked SBE indicators, discussions are continuing specifically with the five Gulf of Mexico NERRs managers (Apalachicola (FL), Grand Bay (MS), Mission-Aransas (TX), Rookery Bay (FL), and Weeks Bay (AL)), resulting in agreement to move forward on visioning the development of a socio-economic observing system (SEOS). The SEOA will complement the System Wide Monitoring Program (SWMP) that currently collects bio-physical data but not socio-economic data. Developing, testing, and successfully implementing a SEOS with the Gulf NERRs could lead to interest from the NERRs nationwide. To continue moving towards a

SEOS, the next step is to collect visitor data at the 5 Gulf NERR sites using a tablet contained in a kiosk. Visitors would voluntarily participate in the survey and answer a variety of questions that would be of interest to NERRs operations as well as a handful of socio-economic questions that would inform the development of a socio-economic observing system or module within SWMP. The survey question design phase is complete and ready for testing at each of the five Gulf NERR sites. These questions address economic impact, recreational use value, stewardship attitude, happiness, access, scientific and education value, and educational literacy. These questions reflect the needs of the workshop participants and are based on the work completed by this project.

REFRENCES

Biedenweg, Kelly, Adi Hanein, Kara Nelson, Kari Stiles, Katharine Wellman, Julie Horowitz, and Stacy Vynne. 2014. "Developing Human Wellbeing Indicators in the Puget Sound: Focusing on the Watershed Scale." Coastal Management 42 (4): 374–90. doi:10.1080/08920753.2014.923136.

APPENDICES

- Appendix 1. List of Participants at meetings and workshops for the SEOS Project Implementation
- Appendix 2. List of SBE Data and Information Needs Identified by Gulf of Mexico National Estuarine Research Reserve (NERRS) Managers.
- Appendix 3. Summary of Participant Survey Feedback Prior to Workshop 1.
- Appendix 4. Summary of Feedback from National Estuarine Research Reserve (NERRS) Managers and Research and Coastal Training Program Coordinators, 2017 NERRS Annual Meeting.
- Appendix 5. Results and graphs of the criteria assessment assessed by participants from Workshop 2.

Appendix 1. List of Participants at meetings and workshops for the SEOS Project Implementation

July 2016 | Gulf of Mexico NERRS Manager Meeting
Keith Laakkonen: Rookery Bay NERR
Jennifer Harper: Apalachicola NERR
Ayesha Gray: Grand Bay NERR
LG Adams: Weeks Bay NERR
Jace Tunnell: Mission Aransas NERR
Matt Chasse: Lake Superior NERR
David Yoskowitz: Harte Research Institute for the Gulf of Mexico Studies
Mayra Lopez: Harte Research Institute for the Gulf of Mexico Studies
Erika Washburn: Lake Superior NERR

May 2017 | Workshop 1 *(* also attended Webinar 1)*
Jennifer Harper: Apalachicola NERR*
Sandra Huynh: Grand Bay NERR*
LG Adams: Weeks Bay NERR
Jace Tunnell: Mission Aransas NERR
Erika Washburn: Lake Superior NERR*
Renee Collini: Gulf of Mexico Sentinel Site Cooperative*
Maya Burke: Tampa Bay Estuary Program*
Amanda Torres: City of Rockport*
Pete Wiley: NOAA*
Sarah Bernhardt: Galveston Bay Estuary Program
Marie Bundy: NOAA*
Heather Wade: Texas Sea Grant*
Ray Allen: Coastal Bend Bays Estuary Program
Kathryn Tunnell: Coastal Bend Bays Estuary Program*
Olga Berkout: Texas A&M University – Corpus Christi
David Yoskowitz: Harte Research Institute for the Gulf of Mexico Studies*
Lauren Hutchison: Harte Research Institute for the Gulf of Mexico Studies*
Kara Coffey: Harte Research Institute for the Gulf of Mexico Studies*
Diana Del Angel: Harte Research Institute for the Gulf of Mexico Studies*
Victoria Ramenzoni: Harte Research Institute for the Gulf of Mexico Studies*

Additional Participants who attended the Webinar 1 following the May 2017 workshop, but did not attend the in-person workshop: Kim Wren (Apalachicola NERR), Rachel Guy (Sapelo Island NERR), Ayesha Gray (Grand Bay NERR), Katya Wowk (Harte Research Institute)

May 2018 | Workshop 2 *(* also attended Webinar 2)*
Jennifer Harper: Apalachicola NERR*
Ayesha Gray: Grand Bay NERR*
Sandra Huynh: Grand Bay NERR*

LG Adams: Weeks Bay NERR*
Jace Tunnell: Mission Aransas NERR*
Kelly Dunning: Mission Aransas NERR*
Rachael Guy: Sapelo Island NERR*
Renee Collini: Gulf of Mexico Sentinel Site Cooperative*
Pete Wiley: NOAA*
Marie Bundy: NOAA
Kathryn Tunnell: Coastal Bend Bays Estuary Program
Michael Jepson: NOAA*
Maria Dillard: NIST*
Lisa Smith: US EPA*
Lisa Colburn: NOAA*
Amanda Torres: City of Rockport
Peter Edwards: NOAA*
David Yoskowitz: Harte Research Institute for the Gulf of Mexico Studies*
Lauren Hutchison: Harte Research Institute for the Gulf of Mexico Studies*
Kara Coffey: Harte Research Institute for the Gulf of Mexico Studies*
Diana Del Angel: Harte Research Institute for the Gulf of Mexico Studies*
Ann Weaver: NOAA

Additional Participants who attended the Webinar 2 following the May 2018 workshop, but did not attend the in-person workshop: Jessica McIntosh (Rookery Bay NERR), Jude Apple (Padilla Bay NERR), Becky Allee (NOAA), Owen Temby (University of Texas Rio Grande Valley), Erika Washburn (Lake Superior NERR), Marie Bundy (NOAA), Heather Wade (Texas Sea Grant), Sally Palmer (Mission Aransas NERR)

Appendix 2. List of Social-Behavioral-Economic (SBE) Data and Information Needs Identified by Gulf of Mexico National Estuarine Research Reserve (NERRS) Managers.

There is an inherent understanding that while the NERRs do an excellent job of collecting bio-physical data through the System Wide Monitoring Program (SWMP) and working with their communities to better manage natural resources and make communities more resilient, that there is critical information on the social and economic aspects of the NERRs that are not well understood. In order to demonstrate the efficacy of a Socio-Economic Observing System (SEOS), the five Gulf NERRs and the Harte Research Institute explored the opportunity to enact such an approach. Motivation for the meeting in Apalachicola was to strategize on how to move out on developing and supporting a socio-economic observing component of SWMP or complementary effort.

A common reason for the NERRs to consider a socio-economic observing system that was expressed was the need to more effectively connect with the community that they serve. While the collection and dissemination of bio-physical data was important, adding in relevant socio-economic data would help strengthen current decision support tools, help make more complete management decisions, and be able to show that environmental improvement is not at the expense of social and economic well-being.

Non Traditional

- Percentage of community connected to natural resource livelihood
  - Income derived from natural resources
- Percentage of income for individuals derived from natural resources
- Happiness Index
  - Quality of Life
- Subsistence fishing and hunting
- Non-consumptive cultural resources and values
- Sense of place (belonging)
- Recreational activities (including biking, kayaking, hiking, swimming…)
- Historical cultural values
- Aesthetics

Traditional

- Fishing guide licenses
- Recreation fishing licenses
  - Crabbing
  - Fisheries (creel surveys)
- Commercial fishing licenses
- Ecotourism guides and associations

- Birding
- Hunting
- Nature Photography
- Recreational Boaters
  - Satellite Data
  - Licenses
- Census data and American Community Survey data
  - Multiple metrics
  - OCM- ENOW data
  - Natural resource employment data
    - GAP-needs nontraditional metric
- Tourism data
  - Chamber of Commerce
  - Beds and occupancy rates
  - Convention and Visitors Bureaus
- Real estate transactions
  - Property values
- Community Rating System data
- Land Use / Land Change data
  - Impervious surface data
- Public access data (State GIS data)

Appendix 3. Summary of Participant Survey Feedback Prior to Workshop 1.

Survey results are described below. A summary of all respondents' answers to each survey question is provided, followed by more detailed information on survey results. Numbers in parentheses represent the number of times this type of information was mentioned in the completed surveys.

> *How are socio-economic (SE) data and information incorporated in your institution's current work? For example, socio-economic information can be incorporated into projects, program justification, and education and outreach initiatives. Please list 3 or more examples and be as specific as possible.*

Summary: Socio-economic (SE) data and information are currently incorporated into participants' work in several main ways: 1) economic benefits and impacts, 2) environmental education and literacy, 3) program and project justification and 4) social vulnerability and resiliency.

- Economic benefit/impacts (GDP, job creation, impact on workforce, employment, CBA, tourism, fisheries/ seafood industry) (10)

- Environmental education and literacy (low science scores, number of teachers and students, public awareness, coastal training program, targeted education programs) (9)

- Program/project justification (number of visitors, distance traveled, member dues paid, grant match, green vs. grey infrastructure) (9)

- Coastal community/social vulnerability/resiliency (Sea Level Rise, social vulnerability index, floodplain impacts, hazards and risks, preparedness and recovery) (7)

- Demographic/population data (4)

- Ecosystem services (recreation, blue carbon) (3)

- Survey data and focus groups, attitudinal changes (3)

- Public/mental health and well being (2)

- Public access (2)

- Social marketing (1)

- Land use changes (1)

- Proximity to port/industries (1)

> *Thinking of future initiatives that your institution will undertake, what types of socio-economic information or data will you need? Please be as specific as possible.*

Summary: The major needs for SE data and information in respondents' future work was aggregated into several categories, including: 1) economic impacts, 2) social vulnerability, 3) nonmarket valuation of ecosystem services, and 4) surveys that document public opinion, attitudes and perceptions or supplement available household data.

- Economic impact (of weather/climate/hydrology changes) on: (eco)tourism (hotels, boat sales), recreation—boating, kayaking, fishing, industry (marine and seafood/ fisheries—catch and landings), commercial sector, health sector, construction (11)

- Social vulnerability (to hazards, storm surge, SLR, flooding, and impact of repeated nuisance flooding / SLR on different communities, environmental changes, risks) (7)

- Nonmarket value of ecosystem services (including economic benefit of environmental resources (value per acre of protected habitat, value per acre foot of water flowing into bay, oyster no harvest areas) (5)

- Surveys (to supplement household data, to document public opinion, attitudes, and perceptions) (4)

- Household income, un/under employment rates (3)

- Quality of life, social health, well being (3)

- Impacts to water quality (effects of non point source pollution, age of housing stock, sanitary sewer overflows) (2)

- Visitor usage data-- attendance (2)

- Demographics (2)

- Change in property value over time-- based on distance to contaminated/restored sites (2)

- Scaled data (local, regional, long-term) (2)

- Environmental/coastal/marine literacy (1)

- Potential for carbon markets (1)

Who are your stakeholders/customers/audience? Please be as specific as possible (e.g. instead of "policy maker", say "Mayor of a small town < 10,000 people).

Summary: Stakeholders most commonly mentioned by respondents were aggregated into categories. Categories most commonly mentioned were: 1) natural/coastal resource managers and decision makers, 2) coastal, rural, and tribal communities and residents, 3) elected officials, 4) the general public, and 5) recreational users.

- Natural/coastal resource managers/decision makers (local/state/regional/federal public and private, state/federal agencies, park/refuge managers, city manager) (13)

- Coastal/rural/tribal communities/residents (10)

- Elected officials (council members, county commissioners, mayors, coastal legislators) (8)

- General public (pre-K, school children, elderly) (7)

- Recreational users (recreational fisherman, hunters, birders, boaters) (7)

- University researchers (students, wetland scientists) (6)

- NGOs, environmental/citizen groups (environmental, voters, minorities, low income) (5)

- Private sector, Industry/businesses (energy, port industries, manufacturers, marinas) (5)

- City/municipal employees (planners, city officials, municipal leaders) (5)

- Tourists (3)

- Marine industry/fisheries workforce (captains, deckhands, commercial fisheries, seafood workers) (3)

- Educators (outreach/extension professionals) (2)

- Homeowners (2)

- Emergency managers (city/county) (2)

- Tourist development council (1)

- Distressed end user (1)

- Government (NIH) (1)

- Port Authority (1)

> *Does your institution have a document (e.g. management plan/strategic plan/guidance document) that guides your work and is it discoverable on the internet? What is it called? If willing, please share the link. 4b. Does it include guidance on incorporating socio-economic considerations in your work? Please explain.*

Summary: All participants were able to provide management or strategic plans that guide their work. In some cases, the participant's work is guided by many different management plans. For example, one respondent mentioned over 10 documents that guide their work.

Of the 12 respondents who answered the question on whether their guidance documents included SE considerations, only 3 mentioned that SE information is included explicitly in these documents. Another 5 respondents mentioned that SE considerations were used to develop the management plan, or were mentioned in the context of developing educational materials, or that SE considerations were included

very minimally or implied. The other 4 respondents expressed interest or mentioned that SE considerations were going to be included in the next version of the management plan.

Appendix 4. Summary of Feedback from National Estuarine Research Reserve (NERRS) Managers and Research and Coastal Training Program Coordinators, 2017 NERRS Annual Meeting.

At the 2017 NERRS Annual Meeting, NERRS Managers, Research Coordinators and Coastal Training Program Coordinators were asked to identify the types of Social-Behavioral-Economic (SBE) data and information needed to inform resource management and decision-making. Information needed is summarized below.

NERRS Managers

Southeast and Caribbean

- Behavior changes as a result of frequent / repeated flooding
- Human health impacts and connections to estuaries (e.g. mosquito control)
- Tracking cultural values and impacts on decision-makers (e.g. financial trade-offs)
- Recreational uses (including levels, change over time, and partner properties economic benefit)
- Understanding spatial changes
- Commercial uses (e.g. crabbing, ecotourism, charter captains, fisheries—including shrimp and crab)
- Real estate (e.g. hedonic study based on shoreline types and changes over time)
- Adaptive development / housing repairs / infrastructure with or without policy - are home / business owners making changes in reaction to flooding disasters not driven by regulation? Policymakers may be more amenable to adopting new regulations…
- Spatial indicators (e.g. indices of land cover / land use, including change over time)
- Demographics of visitors and visitor needs and expectations
- Percent private homes that meet current codes for new residences (e.g. elevated versus ground level)

Mid-Atlantic

- Water quality (for example, assessment of harmful algal blooms, salinity in dry versus wet years and monetary impact strategies (e.g. aquaculture))

- Nuisance flooding (real-time forecast; increase Geographic scale with models; monetary impact -businesses industry -development residences -taxes and tax base)
- Beach and recreational opportunities (and impacts of weather on closures, nonpoint pollution, overflow, combined damage)
- Wild fisheries (habitat quality; storm events; supporting habitats (for example SAV and marshes))
- Resource stewardship (target underserved (urban and rural))
- Career development (target underserved (urban and rural))

Great Lakes

- Monetary/ economic (licenses, fishing, hunting, boating, food, gas, dollars spent on cameras and film, and gear purchases)
- Behavioral (bonds, trust, group membership and participation, social capital characteristics)
- Social, physical and mental health (BP, local food source, stress levels)
- Wild rice
  - Social (trust, social capital, strength of connection, family, tribe, place attachment)
  - Behavioral (physical, mental, family, community ties, BP, obesity, heritage, identity)
  - Economic (informal market values, commercial values, local food values)

Gulf of Mexico

- Boating use areas
- Eco-tourism (for example, habitat changes affecting birding whooping crane)
- Landings and salinity
- Recreational and subsistence fishing (who and where)
- Harmful Algal Bloom outbreaks (and fish kills and algae conditions) linked to hotel stays kayak rentals, uses, where people go, boat launches
- Trail usage at Reserves
- Resiliency of communities to storms, displacement, FEMA housing units by location
- Storm related closures (and shellfish closures) versus fish resources
- Quality of life
- Home values (sales by tract)

Northeast

- Knowledge, attitude, behaviors that relate to our key habitats and natural resource protection goals (and/or resiliency goals) and using this to influence behavior
- Using a logic model so we can be clear about what we want to influence or monitor overtime as NERRS
- Human health and safety
- Salt water damaged personal property due to flooding
- Road damage and repair expenses associated with repeated frequent flooding
- Number of impassable roads and bridges during storms
- Beach tourism and water quality

West Coast and Pacific

- Public use (transportation, recreation, hunting)
- Sediment management costs
- Public health
- Grazing and agriculture
- Food source, algal blooms, shellfish

NERRS Research and Coastal Training Program Coordinators

- Industry makeup
- Economy dependent resources and activities
- Range / area (for example of exported goods) of activities
- Correlation of real estate value and certain biophysical factors
- Environmental benefits to humans
- Purpose of specific structures / economies (for example recreation, jobs, water quality improvement)
- How land use intent changes over time (which may be an indirect measure of community function)
- Maintain indicator observation system rather than hypothesis fulfillment
- Community health data

- Environmentally-driven issues (for example algal blooms, water-borne diseases, wildlife-related illnesses)
- Identify which economic indicators should be correlated to which SWMP parameters
- Population growth and CSOs / water advisories
- Mapping built environment
- Percentage of impervious surface
- Food security
- Public Access
- Structural categories (socio-political, psychological, economic, biophysical, governance, regulatory)

Appendix 5. Results and graphs of the criteria assessment assessed by participants from Workshop 2. This includes the category, ranking, potential metrics and potential data sources.

1

Market economic impact

Potential Metrics
- Change in demand
- Input/output (generalized)
- Expenditure profiles (captures diversity)
- Impact of investment in NERRs
- Number of ecotourism guides and associations
- Type and size
- Average spending of birders/hunters/fishers/photographers
- Number of dollars spent because of ecotourism
- Hotel rooms occupied because of ecotourism

Potential Data Sources
IMPLAN, Survey, State data, ERG NERR funded, chamber of commerce, tourism boards and associations, Convention and Visitors Bureau, national recreation study
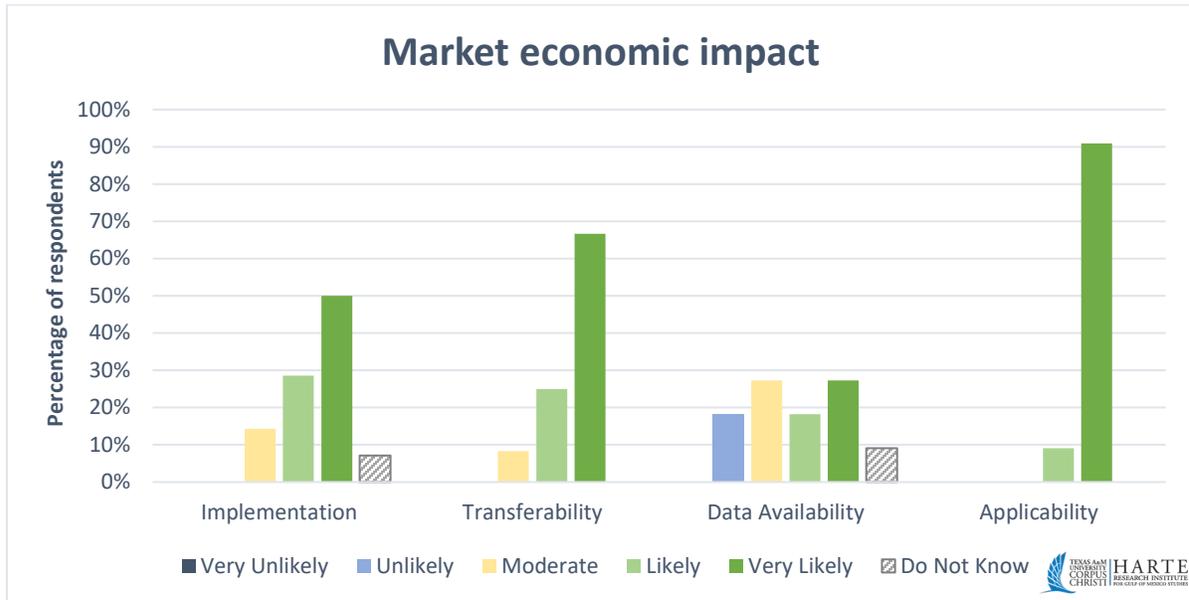
Dependence on natural resources (economic and social)

Potential Metrics

- Commercial, recreational and subsistence resource extraction (including oil and gas extraction)
- Percentage of GDP from environmental jobs/sectors
- Number of jobs
- Self-rating of dependence
- Location quotient
- Willingness to pay for resource (survey)

Potential Data Sources

American Community Survey (ACS), Business planning (related to natural resources and resilience; Ocean Springs, MS), Community planning (South Padre Island and Nueces county, TX), Dun and Bradstreet Corporation, Rating scale, Economics National Ocean Watch (ENOW), Creel (angler) surveys, Targeted surveys, Bureau of Labor Statistics, Texas Workforce Commission, Environmental Response Management Application (ERMA)

Criteria Assessment
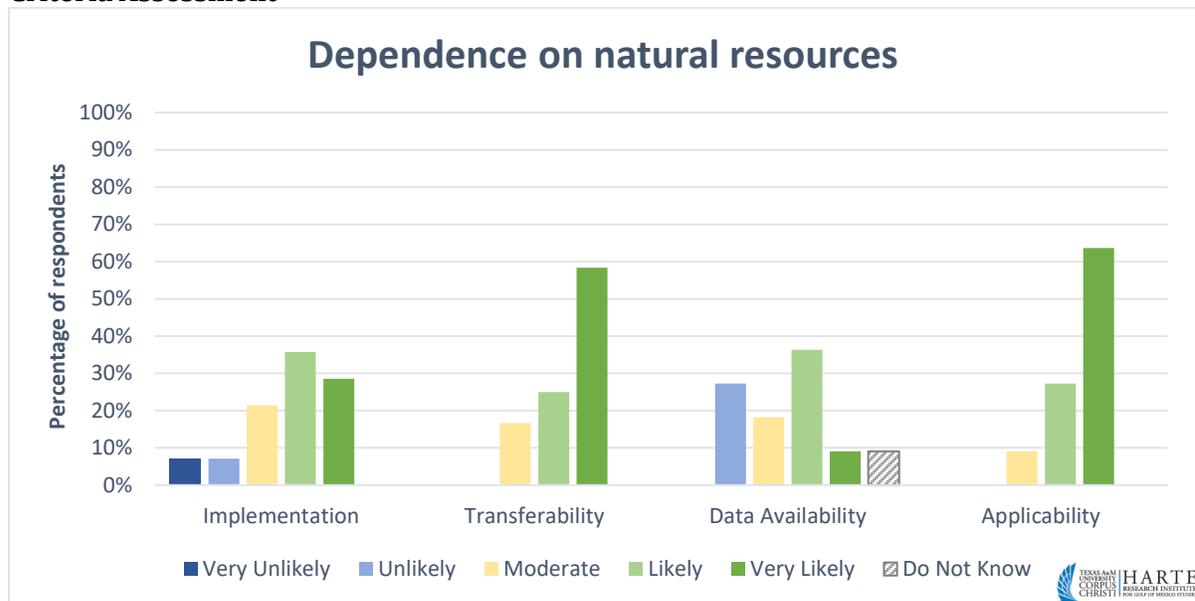
3 **Recreational use value**

Potential Metrics
- Lodging
- Number of fishing guides
- Number of users (consider local vs. tourist)
- Characteristics of users
- Frequency of use
- Number of eBird entries
- Passive use values
- Recreational landings
- Number of permits

Potential Data Sources
Aerial surveys, Marine Recreational Information Program, State surveys, Boating launch counts, Sales from sporting good stores and bait and tackle shops, Rental numbers for boats etc.

Criteria Assessment
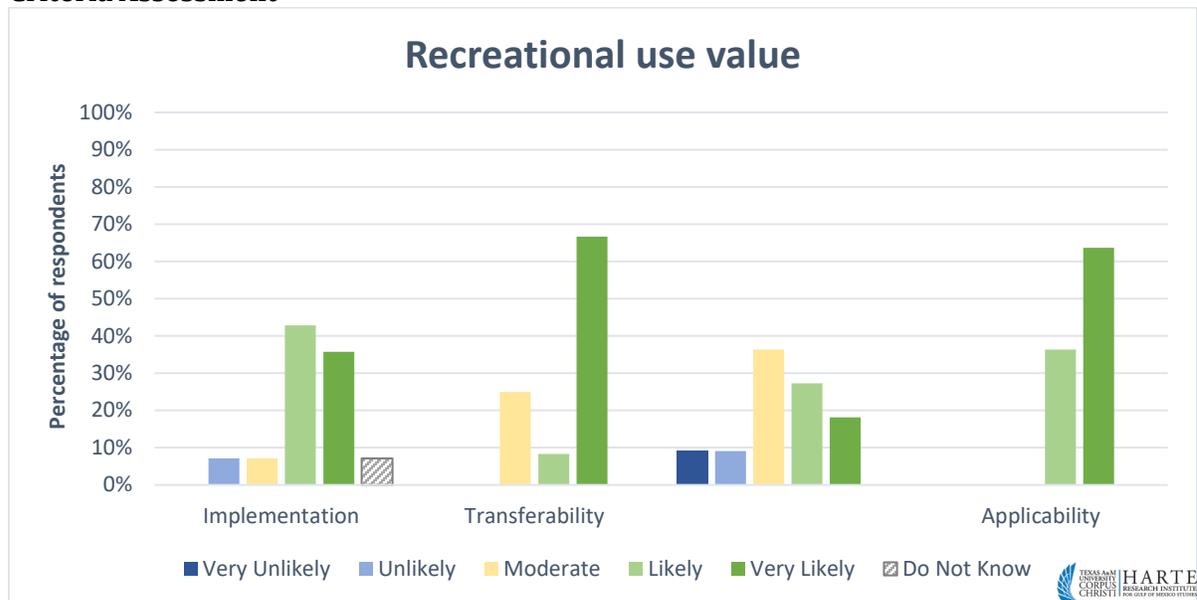
Potential Metrics
- Number of buyouts and acquisitions (acre/plot)
- Number of communities that have incorporated freeboard policy
- Is freeboard required in city ordinances, etc.?
- Floodplain mapping cross-referenced with Community Rating System (Number of communities, scores/class)
- Amount of insurance savings
- Categories of activities
- Amount of points in open space Community Rating System activities
- Insurance claims (number or dollar amount)
- Number of people at or above base flood vs. below base flood
- Ratio of insured vs. uninsured property owners
- Property loss risk
- Policy analysis
- Number of proposed or actual projects
- Number of green mitigation solutions to hazards (including nuisance flooding and SLR)
- Comprehensive plan (or other supplemental plan) in place (Y/N and number of years)

Potential Data Sources
Federal Emergency Management Agency (FEMA) data (flooding insurance claims), hazard mitigation grant recipients, and floodplain administrators, Floodplain managers, NOAA Storm Surge data, Community Rating System Coordinators and Communities, Theses, State floodplain management assessment, Texas Water Development Board, Hazard mitigation grants focused on green infrastructure mitigation solutions, GIS analysis of landcover, American Community survey, Mortgage companies, elevation certificate, Maria Dillard publication, Gulf data atlas, Municipal staff, Community survey
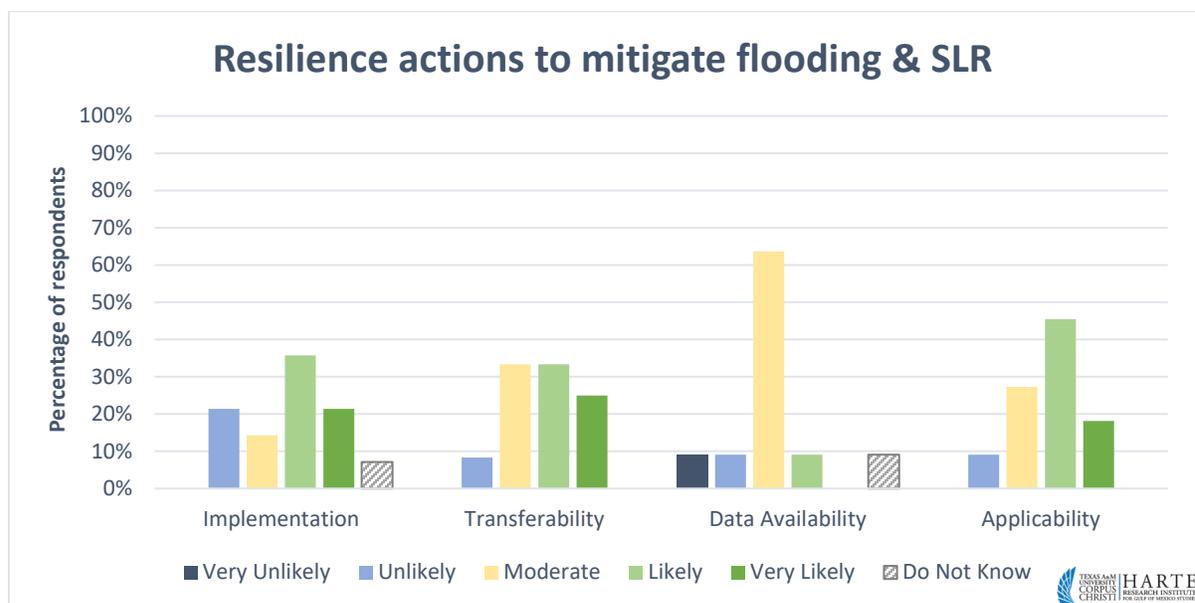
Scientific and educational value (environmental literacy)

Potential Metrics
- Attendance
- School visits
- Number of papers
- Informed decision
- Number of teachers and students reached
- Number of teachers who added curriculum due to training
- Number of teachers who bring students to site
- Number of students educated from a teacher who participated in program
- Number of schools that have nature-based programs or promote natural resources

Potential Data Sources

National Estuarine Research Reserve (NERR) Performance database (maintained by NERR education coordinator), Marine Debris database (TX), Ocean Conservancy Coastal Cleanup, Teachers on the Estuary (TOTE), survey

Criteria Assessment
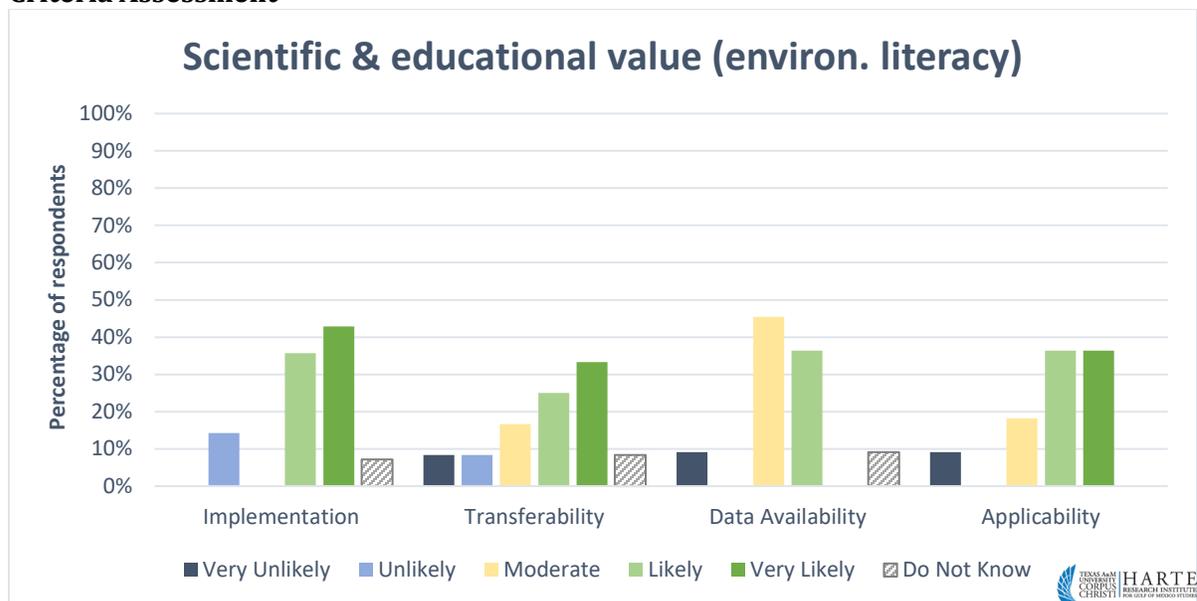
Population dynamics and community characterization

Potential Metrics

- Population blooms- both in-state and out-of-state (for example: in LA: hunting, in TX: winter Texans/snowbirds, or for summer employment, etc.)
- Unemployment rate (by sector)
- Number of people with access to internet
- Number of people with access to local papers
- Average commute time
- Quality of life

Potential Data Sources

Traffic counts, RV parks, Seasonal rentals, Convention and Visitors Bureau

Criteria Assessment
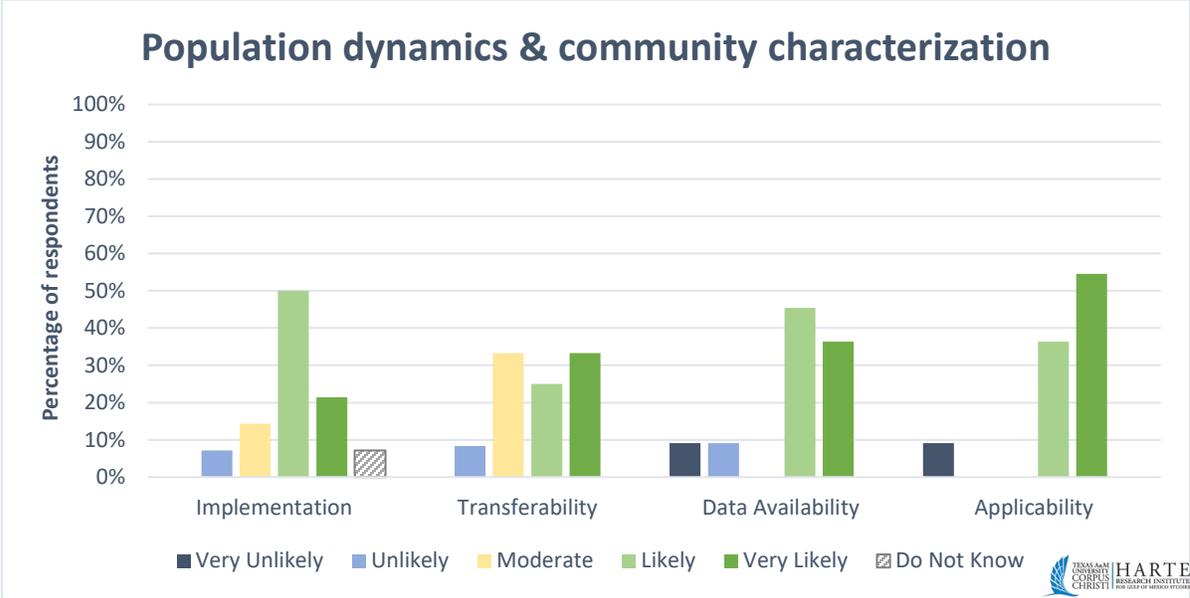
Shoreline and habitat change (ability to provide ecosystem services)

Potential Metrics
- Habitat extent and change
- Ability of habitat to migrate
- Landuse change
- Property value
- Number of times flooded

Potential Data Sources
People who maintain shoreline to mitigate erosion;

Criteria Assessment
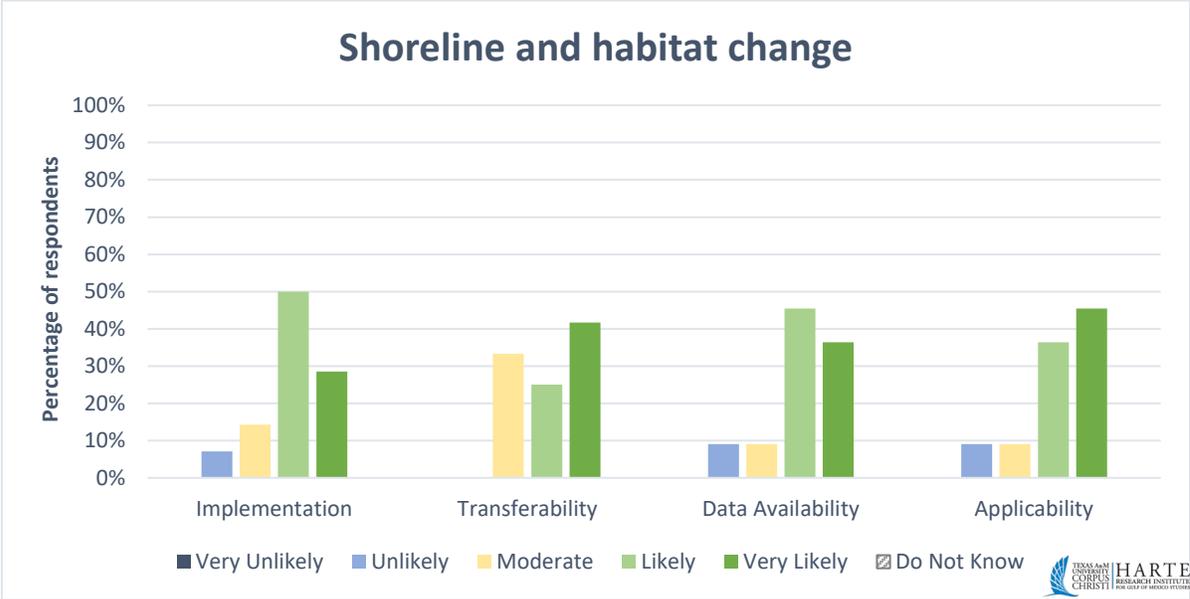
Community vulnerability

Potential Metrics
- Social, economic, and physical vulnerability
- Hazard risk

Potential Data Sources
Marinas (# of slips occupied); Martinich et al. 2013;

Criteria Assessment
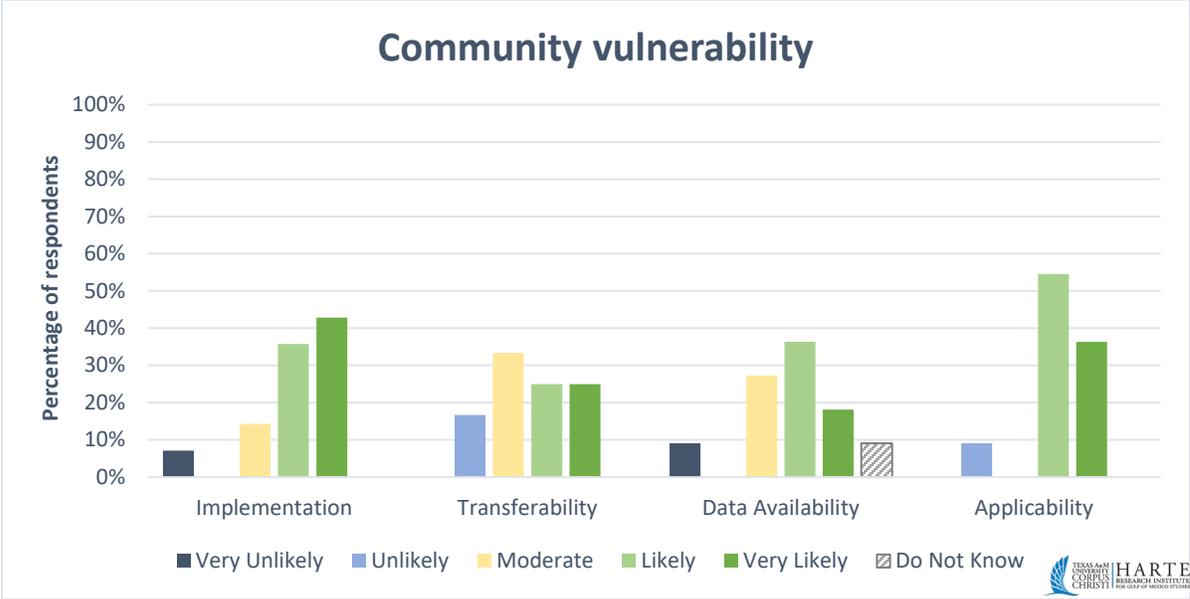
Stewardship / attitude

Potential Metrics
- Knowledge, Attitude and Practices (KAP) metrics
- Residential green: grey
- Number of policies restricting stewardship
- Number of people who understand why freshwater inflow is important
- Does community have mitigation plan to address SLR or flooding?

Potential Data Sources

Pete Wiley kiosk; KAP data

Criteria Assessment
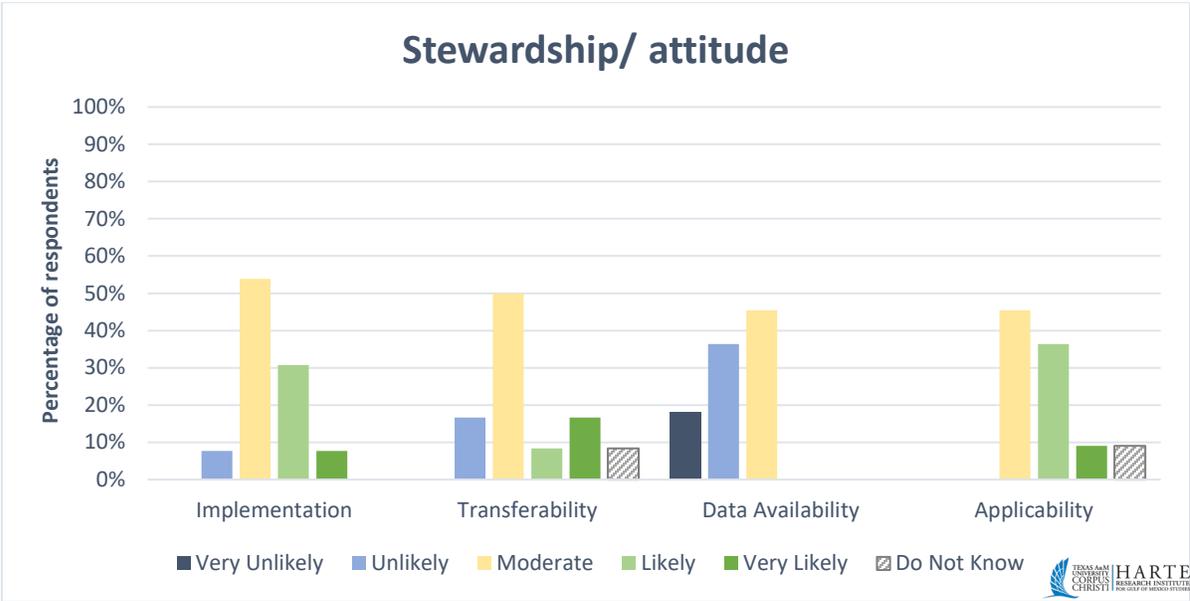
Potential Metrics

- Number of access points (including trails, boat ramps, and piers)
  - Consider: Distribution, diversity of activities, diversity of users and equity of services, private vs. public or managed areas, maintenance/condition
- Proximity to water
- Kayakers

Potential Data Sources

Parking sticker (sales); Entrance fees and counts; Policies on restricted access; survey ccvatch; Local teachers, State department of education, Education and outreach entities

Criteria Assessment
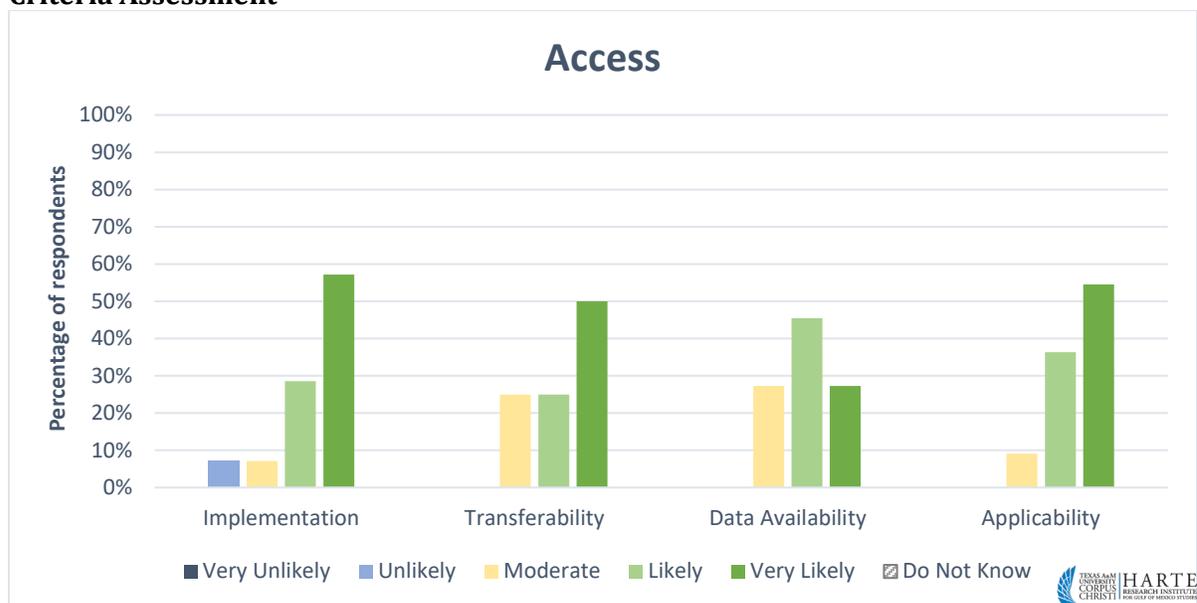
Community connectedness to natural resources

Potential Metrics
- Natural resource use (such as recreational fishing engagement and commercial fishing)
- Proximity to natural resource
- Jobs and livelihood
- Tourism data

Potential Data Sources

Tourism data; State and federal permit data, Beach parking permit data, Fishing license sales, State Park parking pass/entry; Real estate records, FEMA High hazard zone/flood maps, Boat registrations, Convention and Visitors Bureau, Land use data (GIS data), boat ramp surveys (TPWD and MRIP), Michael Jepson?; Surveys of people who fall through the cracks such as bird watchers or trail walkers (survey data collected via kiosks and collecting original data), more refined survey of natural resource use; want to know where people come from and where they go (i.e. boats on water); Marine Recreational Information program (MRIP) data;

Criteria Assessment
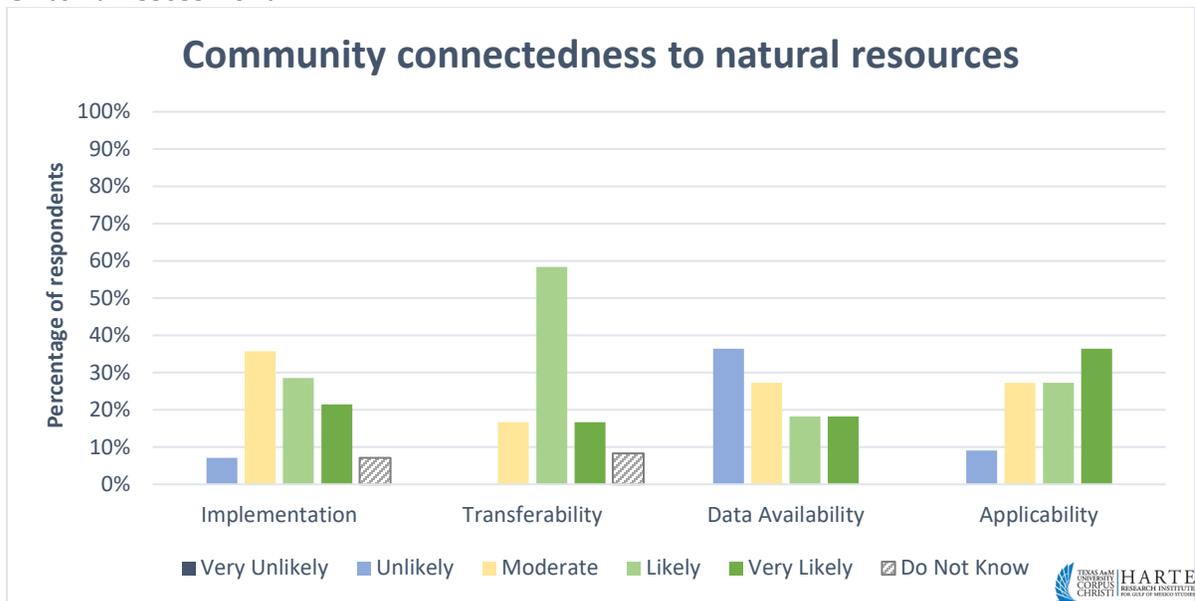
Flood protection (ecosystem service)

Potential Metrics
- Number of nuisance flooding days in relation to impassible roads
  - consider flooding, storm surge, elevated roads and habitats providing flood protection
- Characterize building stock at risk of flooding
  - Consider rented vs. owned, age of tenants, whether or not housing is seasonal; 2nd home

Potential Data Sources
FEMA data (CRS and claims); Phillip Tissot; FEMA Hazus assessments; ESRI business location data; American Community Survey (ACS) data

Criteria Assessment

Flood protection value cost and damage avoided
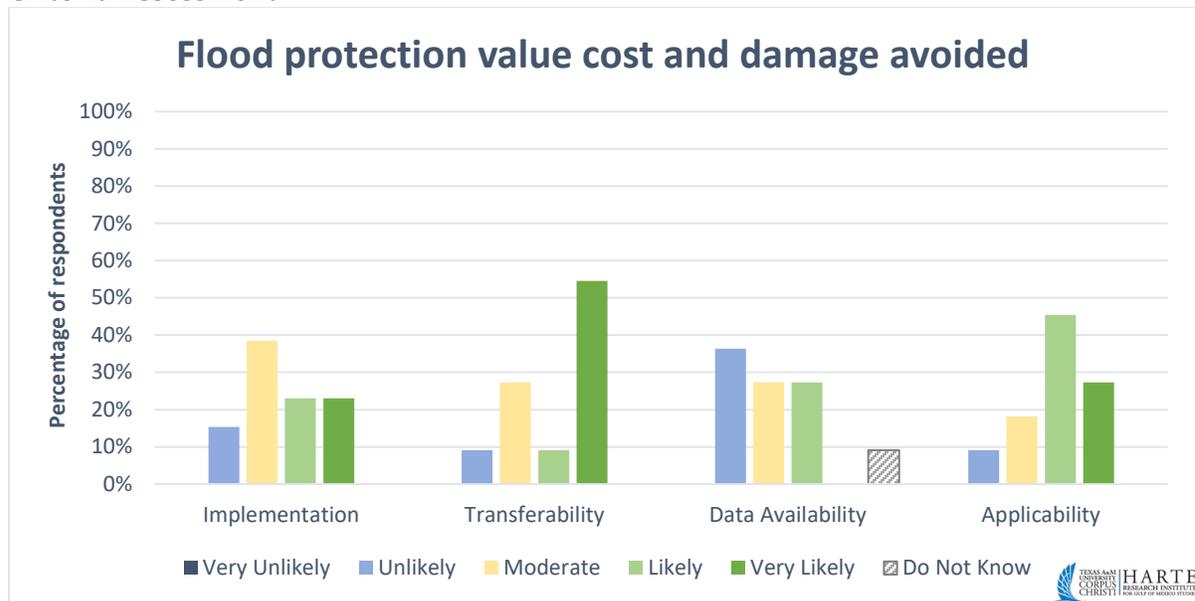
Nuisance flooding impacts

Potential Metrics
- Number of emergency calls on flooded roadways
- Number of acres permitted for filling
- Number of nuisance flooding days
- Number of miles of flooded runways
  - Consider frequency
- Number of flooding claims

Potential Data Sources
Social media, number of calls about flooded roadways,

Criteria Assessment
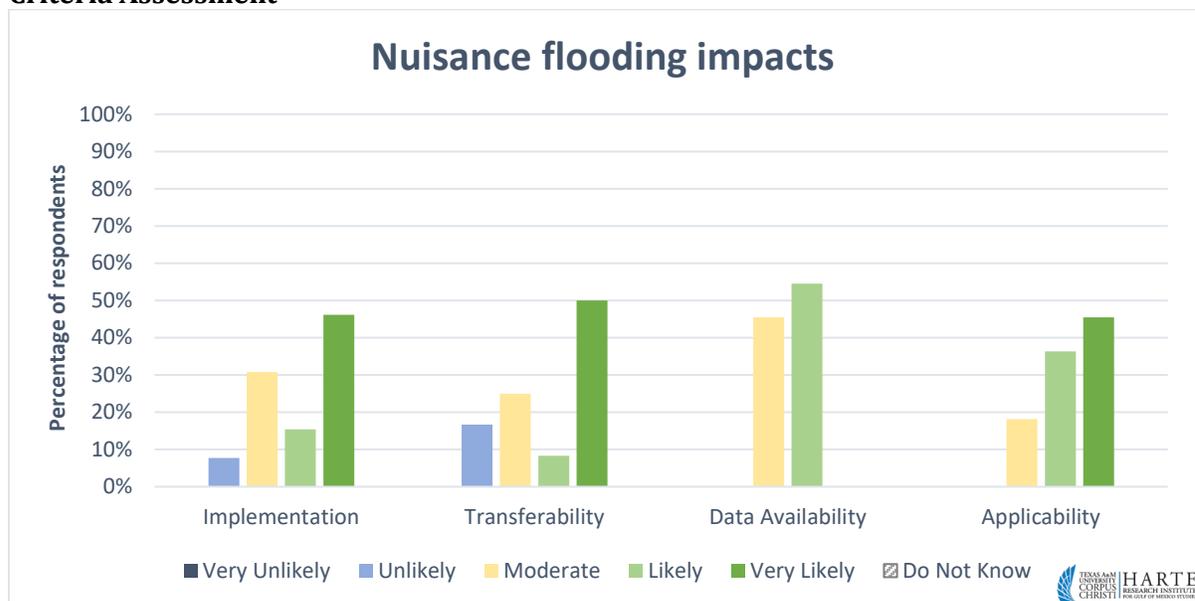
Cultural value

Potential Metrics
- Subsistence fishing
  - Consider social and environmental justice
- Traditional resource use

Potential Data Sources
Oral history database - FL has vaces from the fisheries, survey (hard to measure);

Criteria Assessment
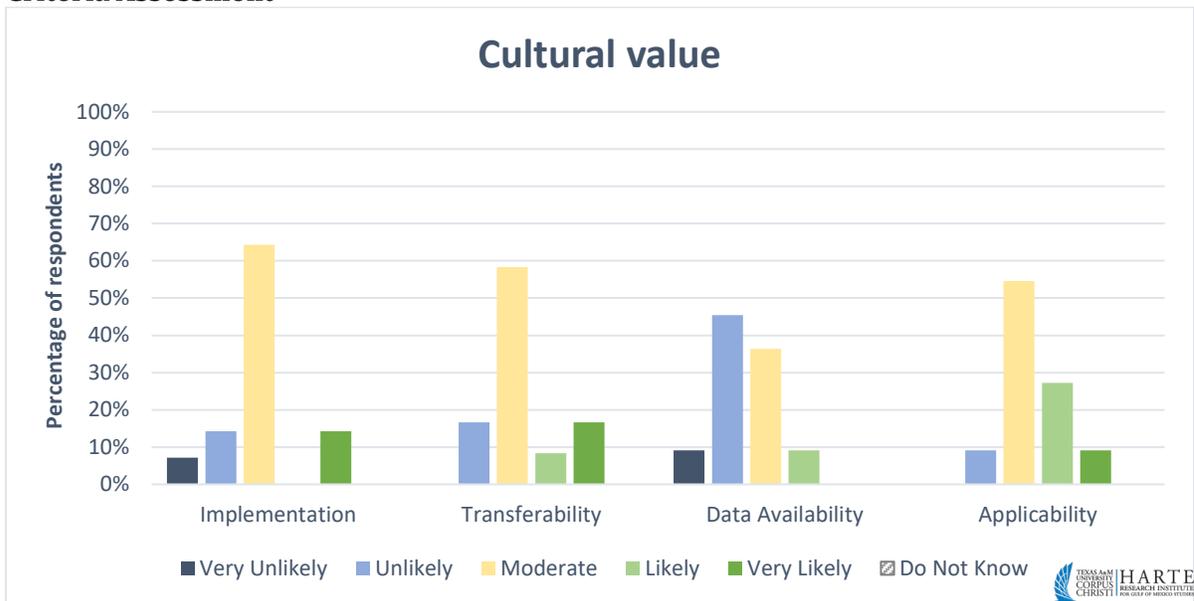
Human health (in connection to natural resources)

Potential Metrics

- Fisheries/ shellfish/ beach closures
- Environmental reports
- Water quality reports
- Number of extreme heat days
- The at-risk population
- Vegetative land cover
- Number of visits to emergency room as related to heat

Potential Data Sources

National and local sources, Public advisories, 303D listings, Local teachers, State department of education, Education and outreach community, American Time Use survey, Local research on measures of stress, Emergency room visits related to heat, Applied Geographic Solutions (look into the metadata)

Criteria Assessment
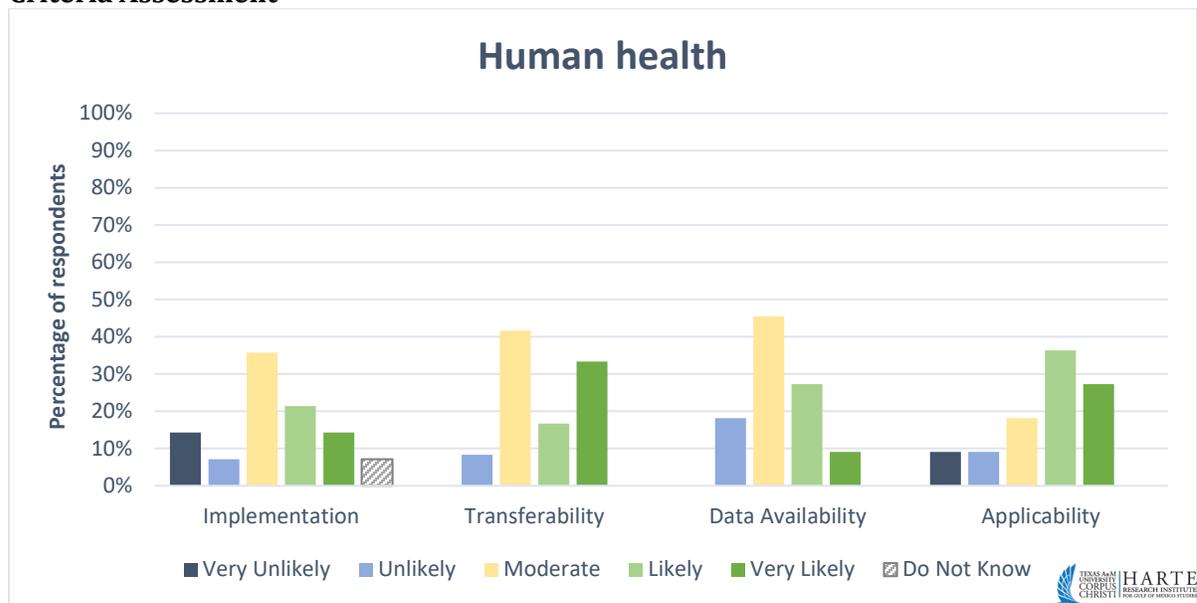
Resilient attitudes

Potential Metrics
- Does community have mitigation plan to address SLR or flooding?
- Perception of natural features ability to reduce risk
- Willingness to take resilience action
- Public risk perception (of public and elected officials)

Potential Data Sources
Local plans; survey data

Criteria Assessment
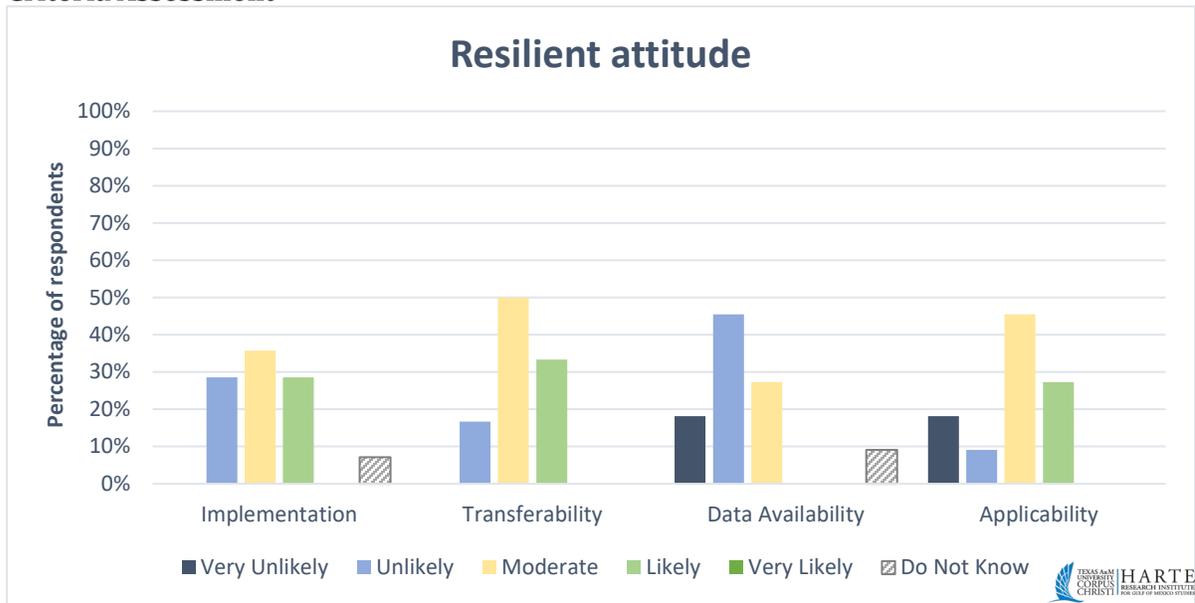
Environmental justice

Potential Metrics
- Spatial analysis of proximity to contaminated sites and flood prone areas
- Socio-demographic profiles
- Housing profiles
- Property value changes

Potential Data Sources
EPA, FEMA, flood maps and census data, SOVI, ACS

Criteria Assessment
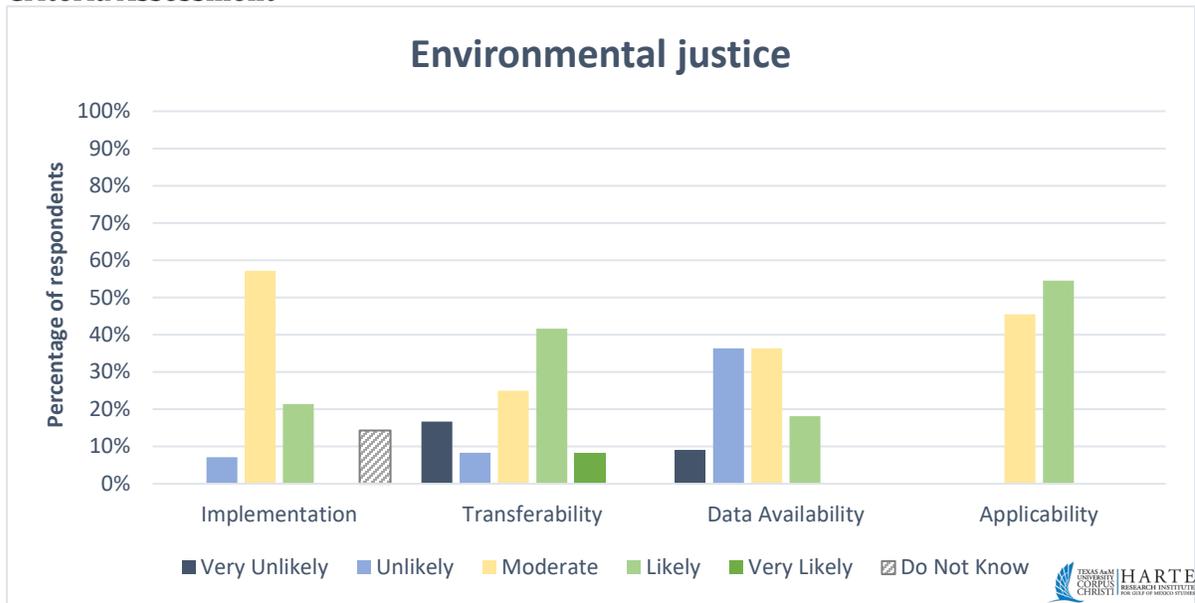
Stewardship actions

Potential Metrics

- Behavioral change (for example, plastic use)
- Reduction of plastic bags/straws (or bans)
- Catch and release
- Participation in environmental events (i.e. beach clean-ups)
- Littering
- Stewardship actions
- Number of dollars allocated to conservation
- Number of NGOs and community and faith-based initiatives

Potential Data Sources

Marine debris data (TX), ocean conservancy (coastal clean-up), TOTE, survey, NERR education coordinator, local budgets

Criteria Assessment
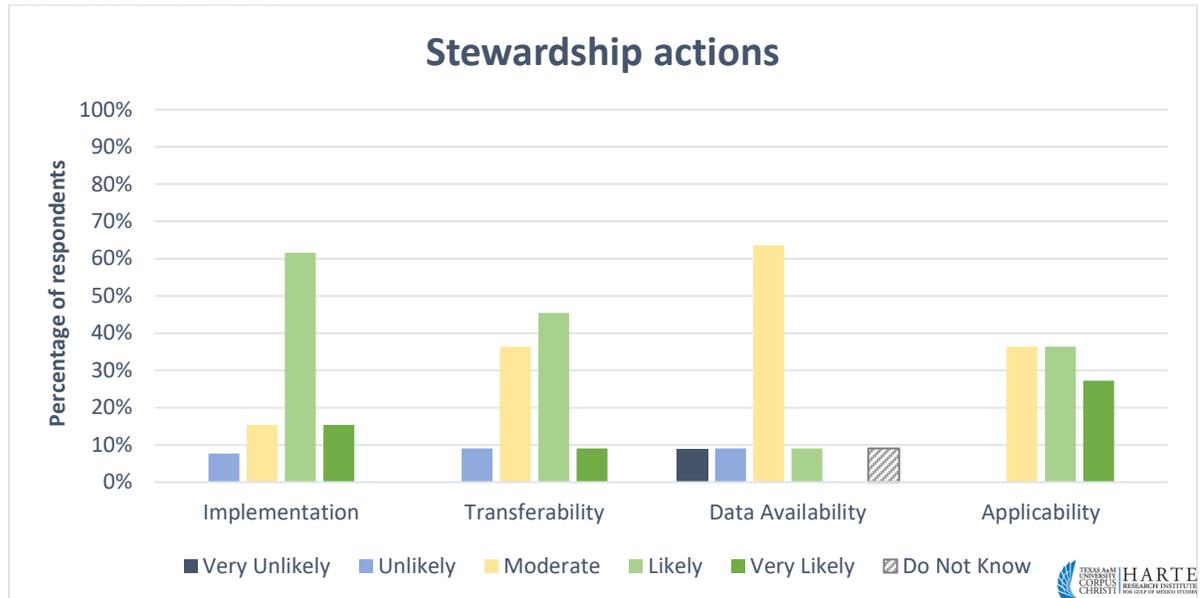
Sense of place (ties to community and environment)

Potential Metrics
- Membership to clubs or civic groups
- Charitable giving
- Number of community organizations
- Survey-based perception of community cohesion
- Social cohesion

Potential Data Sources
tax return data, DWH and Katrina community studies

Criteria Assessment

Sense of place (ties to community and environment)
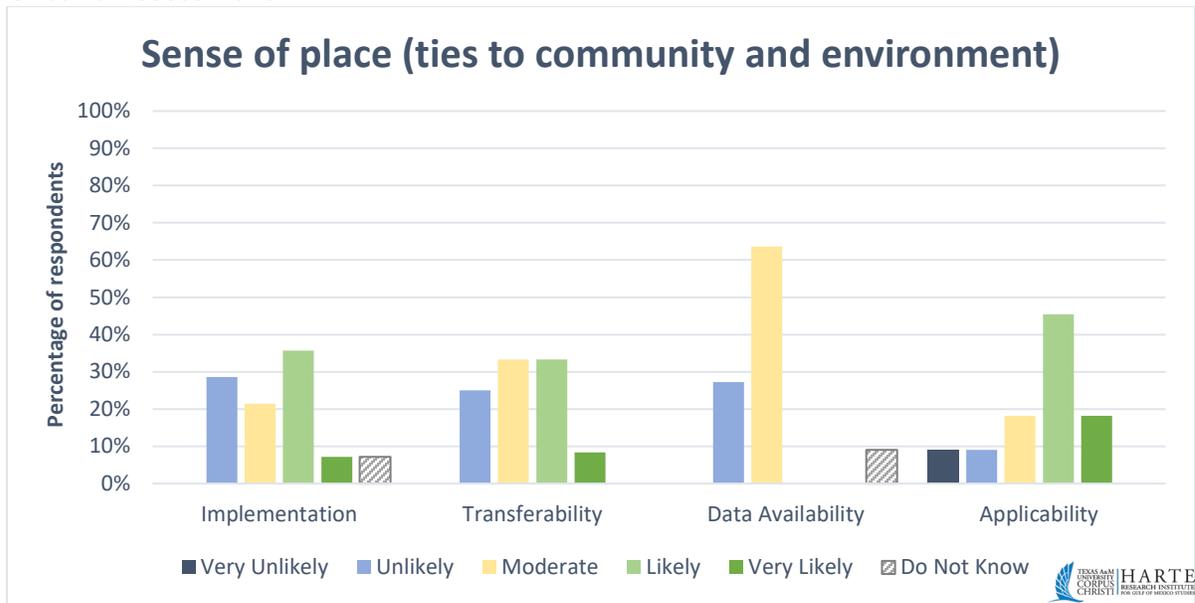
20 **Implementation of resilience actions and activities**

Potential Metrics
- Bond rating
- (Number of) ordinances and legislation encouraging or enabling resilience activities
- Number of different types of topics addressed in relation to hazard risk

Potential Data Sources

Online code catalog (Smart Home America and MS/AL Sea grant-in progress); elected officials/municipal staff ex. Mayors, etc.; CRI aggregation of data;

Criteria Assessment

Implementation of resilience actions / activites

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