TOWARDS COASTAL ADAPTATION THROUGH PLANNING: AN EVALUATION OF PLANS, PROCESSES, AND CHALLENGES IN U.S. ISLAND JURISDICTIONS

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ABSTRACT

This mixed-methods study evaluates coastal adaptation planning in U.S. Island jurisdictions – American Samoa, Commonwealth of the Northern Mariana Islands, Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands – areas where the climate threat and adaptation challenge are great but that have received little planning research attention. This research conceptualizes an evaluation framework based on established plan quality methods and proposed coastal adaptation principles. Employing this framework, the study consists of a quantitative plan quality evaluation of coastal management and hazard mitigation plans across the island jurisdictions. This is complemented by qualitative analysis of interviews with adaptation practitioners, such as coastal managers and hazard mitigation planners. Combined, these approaches provide key insights into the progress and challenges of adaptation on islands and the use of existing planning mechanisms for adaptation planning. The research identifies key recommendations and lessons to be shared across islands, coastal communities, and the federal agencies that support them.

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CHAPTER 1. INTRODUCTION: ADAPTING TO COASTAL CHALLENGES

A. The Coastal Zone

The coastal zone is a dynamic landscape both in terms of the natural and human systems it is comprised of, as well as the human and natural processes that shape it. It is a vivid example of the convergence of natural forces and the force of human nature – where the forces of the sea meet the existence (and resistance) of human settlements. These forces are most evident along developed coastlines, where coastal cities and communities constantly deal with the challenges of living within an ever-changing system of active natural processes. It requires the careful balancing of the use of coastal land and resources, with the impacts of hazards and environmental degradation. There is a diverse set of pressures and interests along the coast (Olsen, 2003) – many of which are in competition for the use of those lands and resources. This competition occurs amidst growing populations and urbanization, increasing pressures on coastal areas around the globe (Kay & Alder, 2005; Neumann et al., 2015). This growing trend has been experienced in the coastal U.S., where almost half of the population resides, and population growth significantly outpaces that of inland areas (NOAA, 2013). With the increasing concentration of people and development along the coast comes increasing economic activity and political pressures to sustain that growth and maintain assets and property (Abel et al., 2011). Impacts of both population and economic growth are particularly concerning in island settings, where resources and land are limited, the ecosystem is especially fragile, and natural hazards are an increasing threat with climate change (Lazrus, 2012). This collision of pressures and impacts is most vivid along the immediate shoreline, where private property and public infrastructure are most at risk and natural resources such as beaches are threatened by efforts to protect those assets against current and future hazards.

B. Coastal Climate Change Impacts

There is an overwhelming consensus that the Earth's climate is changing, with global temperatures rising at unprecedented rates in recent decades. The latest Intergovernmental Panel on Climate Change (IPCC) assessment report confirms the rise in temperature is linked with the rising concentration of greenhouse gases in the atmosphere due to human activity (IPCC, 2021). The effects of increased carbon concentration include rising air and sea temperatures; rising sea levels; ocean acidification; and changing weather patterns, including drought, intensified rainfall events, and stronger storms (IPCC, 2021). Sea levels have been projected to rise by up to 1 meter by 2100 (IPCC, 2021), with some studies projecting possibilities of well beyond that (Sweet et al., 2022). The effects of sea level rise (SLR) and intensifying storms can have drastic impacts on coastal areas, as they are positioned to feel the brunt of climate change (Griggs & Reguero, 2021). These impacts include accelerated rates of chronic coastal erosion and tidal flooding, as well as increased risk of extreme erosion and flooding due to high wave events and storms. Changing air and sea temperatures can also shift global circulation systems which change the typical track of coastal storms, increasing the risk of landfall to some areas not accustomed to extreme storms (IPCC, 2021).

Island jurisdictions in the U.S., which include Pacific and Caribbean island states and territories, are expected to experience all of these impacts, including increased coastal erosion, flooding, and exposure to extreme rainfall events and tropical cyclones (Díaz et al., 2018; Keener et al., 2018). The continuous narrowing and loss of beaches in Hawaii (Anderson et al., 2015; Fletcher et al., 1997; Tavares et al., 2020) and Puerto Rico (Barreto-Orta et al., 2019), the increasing frequency of nuisance tidal flooding (Habel et al., 2020; Sweet et al., 2021), and the active hurricane seasons of recent years is testament to the potential and actual impacts across the islands. These impacts pose major challenges for planners and coastal managers along densely developed coastlines such as the coastal plains of islands, where expansive inventories of critical infrastructure, housing, commercial assets, and valued natural resources are concentrated along the coast. The uncertainty of the magnitude and precise locations of these impacts adds to the challenges of adapting to the hazards associated with climate change. Regardless of the uncertainty, there is growing momentum and recognition of the need for adaptation in islands and coastal communities (IPCC, 2022), although progress has been slow (Reidmiller et al., 2018).

C. Coastal Governance and Adaptation

Managing the challenges along the coast is in the purview of coastal management or coastal governance. *Governance* can be described as the arrangements and processes a society employs to address collective challenges (Ansell & Gash, 2007; Kooiman et al., 2008; Rhodes, 1996). *Coastal governance* encompasses the institutional arrangements, policies, stakeholders, and processes that manage coastal resources and activities, as well as confront the challenges described above (Burroughs, 2011). Coastal governance is often discussed under the auspice of Coastal Zone Management, but its implementation leverages a network of agencies, policies and plans. Planning, and land use planning in particular, is an integral part of coastal governance, as land use regulations and shoreline policies determine the manner in which coastal areas are developed and used (Allmendinger et al., 2002; Tang, 2008). Land use planning has been touted as an ideal mechanism for coastal zone management (Allmendinger et al., 2002); however, its success in achieving stated coastal management objectives varies and requires more study (Macintosh, 2013; Summers et al., 2018). Recent coastal disasters and erosion events in Hawaii, Puerto Rico and elsewhere highlight the limitations of past growth management efforts in protecting coastal property and resources.

Climate adaptation has also been linked to coastal governance, since the challenges facing coastlines, such as ecosystem degradation and coastal hazards, will be exacerbated by a changing climate (Tobey et al., 2010). Adaptation planning is in early stages across the United States (Berke & Lyles, 2013; Bierbaum et al., 2013; Fu et al., 2017a; Lyles et al., 2018) and elsewhere (Gurran et al., 2013; Preston et al., 2011; Tol et al., 2008), but is necessary and critical given the expected impacts along coastlines (Griggs & Reguero, 2021; Moser et al., 2012). Adaptation offers opportunities to align climate actions with coastal management and community planning objectives, reducing risk while

improving coastal communities. Land use planning is a key mechanism for adaptation, especially in coastal areas (Berke & Stevens, 2016; Fu et al., 2017a; Hurlimann et al., 2014; Lloyd et al., 2013; Measham et al., 2011). Land use planning offers tools and processes to steer development away from future hazard areas, incorporate community visions and priorities, and address the uncertainty of climate impacts. Although the need for adaptation is recognized, translating that recognition to actionable plans and progress is challenged by the availability of localized climate information, varying levels of planning capacity, and the fragmentation of planning efforts (Amundsen et al., 2010; Biesbroek et al., 2013; Eisenack et al., 2014).

D. Research Purpose

To address these challenges, the principles of coastal governance, adaptation, and planning all promote an adaptive, learning-based approach through flexible policies and monitoring and evaluation. The proposed research aims to contribute to this learning by combining the principles of coastal adaptation with the methodologies of plan evaluation. There is a robust body of literature and methodologies to evaluate planning for a variety of planning issues, including land use, hazard mitigation, coastal management, and adaptation. These methods provide a systematic approach to gauge the effectiveness of both planning products and processes. Principles of coastal governance and adaptation, in combination with plan evaluation methods, offer a framework for assessing communities' progress and capacity towards adapting their coastlines for the future. The research will focus on the coastlines of island jurisdictions in the U.S. (American Samoa, Commonwealth of the Northern Mariana Islands, Guam, Hawaii, Puerto Rico, U.S. Virgin Islands), where both the climate threat and the adaptation challenge are great. The coastline itself also represents the front line against climate impacts and the intersection between human and natural systems. Adaptation will require acknowledging the impacts to both systems and balancing the needs of each.

The research consists of three parts: the development of a conceptual framework to evaluate coastal adaptation planning, a quantitative plan evaluation of adaptation-relevant plans, and a qualitative analysis of adaptation challenges and capacities of U.S. Island jurisdictions. By highlighting planning as a vehicle for coastal adaptation, this research will collectively examine whether the planning arrangements, processes, and policies in island communities are maximized to achieve coastal adaptation objectives. The study is guided by the following research questions:

1. *What are the principles that should be guiding coastal adaptation planning?*
2. *How well do island jurisdictions' plans incorporate these principles for coastal adaptation?*
3. *What are the planning challenges for coastal adaptation across island jurisdictions, and the capacities needed to overcome them?*

CHAPTER 2. A FRAMEWORK FOR EVALUATING COASTAL ADAPTATION PLANNING

A. Literature Review: Coastal Governance, Adaptation, and Planning Evaluation

How coastal communities address coastal challenges, hazards and climate change varies in approaches and success. Understanding the outcomes and effectiveness of these efforts is critical in identifying successes, gaps, and needs for the future. Knowing the institutional mechanisms and pathways for coordination across scales and sectors, as well as the information and resources available is critical in maximizing efforts to build resilience in coastal communities. These needs point to several fields that share principles, challenges, and approaches – coastal governance, adaptation, and planning. The following sections will discuss the key concepts that organize coastal governance and adaptation, as well as the role of planning in achieving objectives for each field. This is followed by a discussion of the relevant evaluation research to date in each field, highlighting how planning evaluation can serve to gauge and facilitate progress towards coastal adaptation objectives.

1. Coastal Governance

The field of coastal governance often goes by different names, including *coastal management*, *coastal zone management*, *coastal planning*, and *coastal planning and management* (Sorensen, 1997). Although if dissected, the terms planning and management are subtly different concepts (Kay & Alder, 2005; Sorensen, 1997), they are often used interchangeably in the coastal profession. The term *coastal governance* is used here to avoid confusion and to denote the *arrangements* and *processes* of guiding the development of coastal areas and the use of their resources.

The history of coastal governance is characterized by transformative shifts from a singular approach focused on specific sectors or problems, to a more comprehensive approach that integrates multiple issues, stakeholders, sectors and objectives, otherwise known as *Integrated Coastal Zone Management (ICZM)* (Burroughs, 2011; Cicin-Sain et al., 1998; Kay & Alder, 2005). The general goals of ICZM include achieving sustainable development in coastal areas, reducing risk to coastal hazards, and maintaining ecosystem health and biological diversity (Cicin-Sain et al., 1998). Considering these broad goals, coastal governance can involve a multitude of activities, ranging from fisheries and species management, habitat conservation, tourism and recreation management, and economic development, to marine spatial planning, infrastructure planning, land use planning, and hazard mitigation (Beatley, 2012; Marcucci et al., 2010; Sorensen, 1997). Coastal governance, and ICZM, is a framework for planning and managing this diverse set of activities. From the list above, the origin of coastal governance as a sectoral effort is understandable, but the need for integration becomes clear, as many of these activities and issues are interdependent. For example, the land use patterns along the coast may influence water quality, ecosystem health and vulnerability to hazards. Similarly, economic development in coastal areas may have environmental impacts and be facilitated by land use changes. Likewise, mitigating hazard risks may leverage environmental systems and affect economic development opportunities.

Coastal governance activities may include targeted policy interventions related to particular issues, such as environmental degradation or land use. Land use planning is a critical element of ICZM (Beatley, 2012; Kay & Alder, 2005) and even a mechanism for organizing ICZM and achieving coastal objectives (Allmendinger et al., 2002; Lloyd et al., 2013; Tang, 2008). From this perspective, coastal governance may include activities such as zoning, environmental impact assessment, risk and hazard assessment, and enforcing or revising building codes and development regulations to meet coastal goals (Beatley, 2012; Kay & Alder, 2005). As inherent planning actions, these activities may be conducted under established comprehensive planning or collaborative planning processes. The importance is that they are conducted under the consideration of ICZM objectives and integrated across sectors and stakeholders. In outlining the conditions necessary for the success of national ICZM programs, Cicin-Sain et al. (1998) point out that "the planning aspect of ICZM should be integrated into national development planning" (p. 157). It can be argued that this same condition would also apply at the state or local level – meaning that the planning aspect of state or local coastal governance activities should be integrated with comprehensive planning processes related to land use and development at each level.

2. Coastal Adaptation

Adaptation, as defined by the IPCC, is the "a*djustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities*" (IPCC, 2022). The "adjustment" needed is a function of the vulnerability of the system. Vulnerability in the context of climate change is defined as a community's susceptibility to the impacts of climate change and is generally characterized as a function of a community's exposure, sensitivity, and adaptive capacity (Smit & Wandel, 2006). The aim of climate change adaptation then is reducing the exposure and sensitivity of human and/or natural systems and building their adaptive capacity. How adaptation is accomplished is context-specific and requires an in-depth understanding of the conditions contributing to these factors of vulnerability (Smit et al., 2000). Adaptation actions can also be either *reactive* or *anticipatory* (planned) (J. Smith & Lenhart, 1996). Planned adaptation is especially important for addressing climate change while taking advantage of potential opportunities for change (Adger et al., 2005).

Although adaptation planning is generally in its early stages (Bierbaum et al., 2013), the strategies and objectives of adaptation and adaptation planning are not necessarily new, as they can be found within related fields such as urban planning, coastal management, and hazard mitigation, among others (Fussel, 2007a). A unique consideration for adaptation is the need to plan for the uncertainty of climate impacts (Fussel, 2007a). The methods and challenges associated with adaptation planning are receiving increasing attention in the planning literature, particularly at the local level (Berke & Lyles, 2013; Hurlimann et al., 2014; Measham et al., 2011), as climate impacts are felt locally. Municipalities can employ one of two approaches for adaptation planning – a *narrow-scope* approach with dedicated plans to address climate impacts, or a *broad-scope* approach in which adaptation is embedded in existing

planning mechanisms (Lyles et al., 2018), otherwise known as 'mainstreaming' adaptation (Klein, 2001; USAID, 2009). Urban planning is therefore a critical tool for adaptation (Berke & Stevens, 2016; Butler et al., 2016; Hurlimann et al., 2014). Local planning systems and capacity have the potential to facilitate or hinder adaptation (Hurlimann et al., 2014; Macintosh, 2013; Measham et al., 2011). Barriers for local adaptation include *weak constituency around adaptation*, *state or higher-level policy constraints*, and *local planning deficiencies* (Baker et al., 2012; Berke & Lyles, 2013; Shi et al., 2015). These local planning deficiencies may be structural, procedural, or contextual (Baker et al., 2012). Coastal communities highlight the contextual nature of adaptation challenges; as coastal processes, landscapes, and hazard risks vary along the shoreline; as do stakeholders, development patterns, public/private property boundaries and shoreline management regimes (Mitsova & Esnard, 2012). Although nuanced, these variations introduce common coastal adaptation challenges related to political will, coastal justice and property rights, and the limitations of public intervention (Cooper & McKenna, 2008; Stallworthy, 2006).

Adaptation must be considered amid the already complex challenges of managing the coastline. Indeed, researchers have noted that the need to adapt to climate impacts both challenges and is addressed through existing coastal governance mechanisms (Duxbury & Dickinson, 2007; Moser et al., 2012; O'Donnell, 2019; Tobey et al., 2010; Tol et al., 2008; Tribbia & Moser, 2008). The environmental and development policies that manage and regulate coastal activities, particularly along the shoreline, influence the types of strategies that are both locally acceptable and feasible. For coastal communities, adaptation includes strategies to *protect* coastal property and infrastructure, either through 'hard' structures (e.g. seawalls) or 'soft' measures (e.g. beach nourishment); to *accommodate* the hazards through building codes, building elevation, or green infrastructure; or to *retreat* from the coastline (Butler et al., 2016; Douglas et al., 2012; Kirshen et al., 2008; Klein et al., 2001; Tol et al., 2008). These strategies are also common to erosion management approaches and literature (Porro et al., 2020; Rangel-Buitrago et al., 2018; Williams et al., 2018). *Managed* r*etreat* strategies focus on minimizing development in hazardous areas through relocating or preventing development. This effort leverages land use tools and policies, such as zoning, setbacks, easements, and land acquisition to steer development away from the coastline (Beatley, 2012; Mitsova & Esnard, 2012). Managed retreat has to date been mostly implemented reactively through post-disaster land acquisition or relocation efforts (Butler et al., 2016; Mach et al., 2019; Siders, 2019a). Anticipatory retreat has proven more challenging (Gibbs, 2016; Siders, 2019a), but is a necessary and urgent option for successful adaptation (Mach & Siders, 2021; Siders et al., 2019). These strategies are often dispersed among planning documents, such as land use or comprehensive plans, hazard mitigation or resilience plans, or increasingly in stand-alone adaptation plans (Butler et al., 2016; Fu et al., 2017a; Keenan, 2018; Preston et al., 2011).

3. Evaluation of Coastal Governance, Adaptation, and Planning

a) Evaluation of Coastal Governance

Coastal governance, and particularly ICZM, is seen as a continuous iterative effort driven by evaluation and learning (Olsen et al., 1997), highlighting the adaptive management aspect of ICZM (Ehler, 2003; Olsen et al., 1997). Coastal governance success is often measured based on the effectiveness or progress of ICZM program development and implementation. There is much research evaluating the effectiveness of national programs. Ehler (2003) uses four types of indicators to assess marine protected area governance performance in Canada – *inputs, processes, outputs, and outcomes*. Kearney et al. (2007) also examine coastal governance in Canada, evaluating its effectiveness at achieving participatory governance principles. Lowry et al. (2005) assess the effectiveness of the decentralization of coastal management in the Philippines through the lens of 6 governance indicators – *management authority, management capacity, resources, commitment, coordination, and accountability*. Harvey & Clarke (2019) examine the series of coastal program reforms in Australia in the context of international ICZM advances. Research has also examined the effectiveness and progress of coastal governance in the U.S. (Bernd-Cohen & Gordon, 1999; Godschalk, 1992; Lowry, 1985; Lowry et al., 1993). Lowry (1985) and Godschalk (1992) examine the design and implementation of the U.S. coastal zone management program through its first decades. Bernd-Cohen & Gordon (1999) focus their assessment at the state-level, examining the effectiveness of state coastal programs to address the protection of natural shorelines.

The above studies relate to the evaluation of ICZM programs. Evaluating planning and policy actions of ICZM is much more contextual and concerned with outcomes, such as the quality of ecosystem health, the reduction or increase of hazard risk, or the alleviation or creation of conflict – all at least partially associated with the pattern of development along the coast. Some have evaluated the broad interaction between coastal policies, authorities, and development and their influence on specific issues, such as disaster risk (Bagstad et al., 2007; Duxbury & Dickinson, 2007; Neal et al., 2018); social and environmental justice (Cooper & McKenna, 2008; Stallworthy, 2006); and shoreline erosion, in Europe (Cooper & McKenna, 2008; McKenna et al., 2009; O'Connor et al., 2010), Australia (Gordon, 2021; Wescott, 2004), the U.S. (Blizzard & Mangun, 2008; Dunn et al., 2000; Titus, 2000; Windrope et al., 2016), and specifically in Hawaii (Kittinger & Ayers, 2010; Summers et al., 2018).

Some have evaluated this interaction between policy and coastal outcomes with a specific lens towards planning, such as the influence of mandated shoreline management plans in the UK (Cooper et al., 2002; Milligan & O'riordan, 2007; O'Riordan & Ward, 1997) and coastal action plans in Australia (Wescott, 2004). Others have focused on the broader role of land use planning in coastal governance (Allmendinger et al., 2002; Lloyd et al., 2013; Tang, 2008). Allmendinger et al. (2002) examine the capacity of planning mechanisms to adapt to the demands of ICZM through a study of three local authorities in Scotland. They find that planning has not fulfilled its potential of achieving ICZM due to

various local barriers, but that land use planning can serve as a framework to coordinate coastal management activities, integrate fragmented planning efforts, and resolve conflicts.

b) Evaluation of Adaptation Planning

Because of the uncertainty surrounding climate change impacts, planned adaptation is a constant learning process (Berke & Lyles, 2013; Bierbaum et al., 2013; Fussel, 2007; Moser et al., 2008). Effective evaluation of adaptation is critical to facilitate this learning process (Silva Villanueva, 2011). Criteria for successful adaptation depends on what is being evaluated (Silva Villanueva, 2011), such as the adaptation options (Smith & Lenhart, 1996), adaptation processes and outcomes (Adger et al., 2005; Hurlimann et al., 2014; Silva Villanueva, 2011), or adaptation plans themselves (Baker et al., 2012; Fu et al., 2017a; Preston et al., 2011). Criteria for adaptation options include *flexibility/performance under uncertainty*, *cost*, *net benefits*, co-benefits, *public acceptability/political feasibility*, *urgency*, *environmental sustainability*, *cultural compatibility*, and *benefits independent of climate change* (Klein et al., 2001; Smit et al., 1999; J. Smith & Lenhart, 1996; Titus, 1998). Criteria for successful adaptation more generally, to include processes and outcomes, include *sustainability*, *integration*, *participation/collective action*, *local ownership*, *effectiveness*, *efficiency*, *legitimacy*, and *equity* (Adger et al., 2005; Hurlimann et al., 2014; Pringle, 2011). There is growing literature on the evaluation of adaptation plans themselves, primarily based on plan quality criteria and plan components (Baker et al., 2012; Fu et al., 2017a). Adaptation planning evaluation research has employed various methods to examine both planning processes and planning products (plans) at various scales.

Bierbaum et al. (2013) review the current state of adaptation and adaptation planning in the U.S. across government scales and private and non-profit sectors. Through a systematic qualitative review of peer-reviewed and grey literature, they review activities and progress against a generalized adaptation policy process and find that adaptation planning is generally in beginning stages in the U.S. with few examples of successful implementation and therefore little evaluation of adaptation planning outcomes. They highlight several research needs for adaptation planning, including identifying criteria for evaluating governance and capacity, and ways to incorporate adaptation into existing processes. Several have explored the processes and planning systems in which adaptation occurs at the local level, with specific implications for urban and land use planning (Hurlimann et al., 2014; Macintosh, 2013; Measham et al., 2011). These studies qualitatively evaluate the broader governance and planning frameworks that impact adaptation progress and processes on select cases in Australia, but do not compare progress across jurisdictions or examine the role of planning products (plans) in adaptation. Others have employed quantitative methods to assess and compare adaptation progress across jurisdictions through a focus on adaptive and planning capacities of cities (Shi et al., 2015); or the quality and content of local climate action plans in the U.S. (Tang et al., 2010, 2013), local comprehensive and hazard mitigation plans (to address sea level rise) across U.S. cities (Fu et al., 2017a), local climate change plans in Canada (Guyadeen et al., 2019), adaptation plans in European cities (Reckien et al., 2023), adaptation plans in

developed nations (Preston et al., 2011), or the progress of adaptation planning across U.S. states (Miao, 2019; Ray & Grannis, 2015) or across scales (Kettle & Dow, 2014). Some researchers have employed mixed methods, combining plan evaluation or other quantitative approaches with qualitative methods to evaluate adaptation planning progress, capacity and barriers at the local level (Baker et al., 2012; Butler et al., 2016) and at the state level (Bedsworth & Hanak, 2010).

c) Planning Evaluation

Many of the above studies are influenced by a broader plan evaluation literature. As in coastal governance and adaptation, evaluation is an integral part of the planning process (Baer, 1997; Berke & Godschalk, 2009; Lyles & Stevens, 2014; Talen, 1996). The role and methods of evaluation in planning have been examined broadly (Alexander & Faludi, 1989), with scholars offering frameworks and criteria to evaluate collaborative planning processes (Innes & Booher, 1999), plan implementation (Talen, 1996), and plan quality (Alexander & Faludi, 1989; Baer, 1997). Plan quality evaluation research has seen considerable growth in recent years (Berke & Godschalk, 2009; Lyles & Stevens, 2014). Since Baer (1997) posed a first set of plan quality criteria, there is now a well-established body of literature related to plan quality evaluation, with researchers converging on a set of recognized plan quality principles associated with plan components (Berke & Godshalk, 2009; Lyles & Stevens, 2014). In a meta-analysis of plan quality research, Berke and Godshalk (2009) categorize these as *internal* plan quality principles, or those related to the content and format of plans, and *external* principles, or those related to stakeholder values and local context. More recently, in an evaluation of recovery plans Berke et al. (2014) organized principles based on those that are *direction-setting* principles and those that are *action-oriented* principles, as listed in Table 1 below. Many have used a variation of this set of criteria to assess plan quality, with 5 plan components – *goals*, *fact base*, *policies*, *interorganizational coordination*, and *implementation & monitoring* – being the most common. Some have added *participation* in recognition of the need for stakeholder input (Berke et al., 2012, 2014).

Table 1 - Common Plan Quality Principles*

Berke and Godshalk (2009)	**Berke et al. (2014)**
Internal Quality *Issue identification and vision* *Goals* *Fact base* *Policies* *Implementation* *Monitoring and evaluation* *Internal consistency*	**Direction-Setting** *Goals* *Fact base* *Policies*
External Quality *Organization and presentation* *Interorganizational coordination* *Compliance*	**Action-Oriented** *Interorganizational coordination* *Participation* *Implementation and monitoring*

**Modified from Berke & Godshalk (2009) and Berke et al. (2014)*

Researchers have applied these or modified criteria to assess plan quality through a variety of planning lenses, including coastal management (Tang, 2008), climate change (Baker et al., 2012; Fu et al., 2017a; Tang et al., 2010, 2013; Wheeler, 2008; Woodruff, 2016), sustainable development (Berke & Conroy, 2000), ecosystem management (Brody, 2003), tsunami preparation (Tang et al., 2008), disaster recovery (Berke et al., 2014), and hazard mitigation (Berke et al., 2012; Berke et al., 2014; Horney et al., 2017a; Lyles et al., 2014). Depending on the research question and planning domain, the criteria and indicators for each criterion may be tailored to the study goals (Lyles & Stevens, 2014). For example, Tang (2008) and Fu et al. (2017) used the plan quality principles above to assess coastal land use and adaptation plans, respectively, modifying the indicators for each criterion to those most relevant to coastal management and adaptation. Tang et al. (2010, 2013) used the *Awareness-Analysis-Action* framework as criteria to assess climate action progress, whereas Baker et al. (2012) use both the *Awareness-Analysis-Action* framework and plan quality principles to assess adaptation planning progress and quality. Berke and Conroy (2000) assessed comprehensive plans against sustainable development principles, while Woodruff (2016) and Woodruff et al. (2018) added 'uncertainty' to the commonly used plan quality principles (Table 1) to assess adaptation and resilience plans.

Although the criteria and indicators used may change, the common characteristic of plan quality studies is the systematic evaluation of select plans against "normative criteria" (Lyles & Stevens, 2014, p. 2). These studies typically employ content analysis methods, extracting measurable data from plan text using a prescribed coding protocol and scoring system tailored to research interests and capacities (Berke & Godschalk, 2009; Lyles & Stevens, 2014; Norton, 2008). Plan quality studies generally result in quantitative indices expressing the quality of plans for each criterion or plan component. Some studies employ statistical or correlation analysis to determine the influence of external factors on plan quality. These methods are useful in not only understanding the quality of existing plans, but also can inform plan updates or new planning efforts (Berke & Godschalk, 2009).

Another characteristic of most plan evaluation studies to date is that the object of analysis is an individual plan. Comparisons are often made between similar plans across jurisdictions, but the measure is of the quality of each plan and its contents. Recently, plan evaluation research has begun to look beyond the quality of individual plans to the integration of the network of plans within a jurisdiction (Berke et al., 2015, 2019; Berke et al., 2018; Lyles et al., 2018; Malecha et al., 2018; Newman et al., 2020). A community may be subject to a multitude of plans that affect how land and resources are used and developed. Depending on governance and planning structures, these plans may include comprehensive plans, transportation plans, hazard mitigation plans, and coastal or watershed management plans among others. Oftentimes these plans are developed in isolation, without attention paid to the objectives and policies of other plans within the jurisdiction. This can lead to not only a misalignment of objectives, but also contradicting policies for the same area within a community. For example, a hazard mitigation plan may call for increased setbacks or no-build zones within a community, when a transportation plan or

comprehensive plan may call for intensified development or new infrastructure in the same area. Researchers have begun to examine this plan integration issue in relation to climate adaptation (Lyles et al., 2018) and vulnerability to flooding (Berke et al., 2015, 2019; Berke et al., 2018; Malecha et al., 2018, 2021). For example, Lyles et al. (2018) use content analysis procedures to evaluate the integration between adaptation plans and 'adaptation-supportive' plans by identifying references to other plans within planning documents. Others have used a resilience scorecard, content analysis and mapping procedures to identify how land use policies across a network of plans collectively affect vulnerability to flooding (Berke et al., 2015; Berke et al., 2018; Malecha et al., 2021).

4. Summary and Research Direction: Coastal Governance, Adaptation, and Planning

a) The Coastal Governance - Adaptation - Planning Connections

Although often distinct areas of research, *coastal governance*, *adaptation*, and *planning* are intricately connected in both practice and research. The coastal governance literature points to the complexities of managing coastal areas amid conflicting uses and objectives, nuanced planning and policy structures, and complex interactions between human and natural systems. Climate adaptation happens amid similar circumstances, with the added consideration of uncertainty of climate impacts and vulnerability to those stresses. There are inherent ties between coastal governance and adaptation, none more evident than climate impacts, such as sea level rise and intensifying storms, occurring in coastal communities. Coastal adaptation places the necessary 'adjustment of systems' to climate impacts within the purview of coastal managers. These impacts compound and exacerbate the issues coastal managers are already facing (Moser et al., 2008; Tobey et al., 2010; Tol et al., 2008); so the resilience, effectiveness, and flexibility of coastal governance is also tested. Planning plays a critical role in addressing these challenges, both through the policies that drive coastal land uses (Allmendinger et al., 2002; Fu et al., 2017a; Tang, 2008) and the processes by which communities are engaged and decisions are made (Berke & Lyles, 2013).

Further connections have been highlighted by those that have specifically looked at the relationship between coastal governance and adaptation (Falaleeva et al., 2011; O'Donnell, 2019; Tobey et al., 2010; Tol et al., 2008; Tribbia & Moser, 2008), or focused their adaptation studies on coastal issues such as retreat (Abel et al., 2011; Gibbs, 2016; Siders & Keenan, 2020), recognizing that for coastal communities, climate adaptation is facilitated or hindered by existing coastal management structures and policies that manage the shoreline. Adaptation is also influenced by planning frameworks and processes, with adaptation strategies typically outlined in dedicated adaptation plans or spread across multiple plans or embedded within comprehensive plans (Lyles et al., 2018). Adaptation is also affected by local planning capacities and priorities (Berke & Lyles, 2013; Hurlimann et al., 2014; Macintosh, 2013).

The importance of learning is emphasized in both coastal governance and adaptation literature, fueled by adaptive management and anticipatory governance approaches (Berke & Lyles, 2013; Olsen &

Christie, 2000; Duxbury & Dickinson, 2007; Forst, 2009; Olsen, 2003; Preston et al., 2011; Tobey et al., 2010; Tol et al., 2008). This learning comes through institutionalized evaluation and monitoring in planning efforts, as well as through evaluation research. As relatively new fields, evaluation research of coastal governance and adaptation is growing, pointing to maturing practices with lessons learned along the way. Research often points to missed opportunities to leverage these frameworks to achieve objectives. For example, Falaleeva et al. (2011) highlight the need to better align fragmented sector-driven local coastal management efforts and ambiguous top-down adaptation policies in Ireland. Allmendinger et al. (2002) highlight land use planning as a possible framework to achieve ICZM, but that it hasn't been leveraged effectively in Scottish localities. Similarly, researchers have highlighted missed opportunities of leveraging planning to achieve adaptation objectives in Australia (Hurlimann et al., 2014; Macintosh, 2013).

Similar findings have been highlighted in Hawaii, showing that coastal management policies have failed to achieved CZM beach preservation objectives amid sea level rise and development (Kittinger & Ayers, 2010; Summers et al., 2018). The quality of plans related to coastal land use and adaptation has been lacking against known plan quality criteria (Baker et al., 2012; Fu et al., 2017a; Preston et al., 2011; Tang, 2008; Tang et al., 2010). Also, the integration among a community's network of plans can be improved to better reduce vulnerability to climate change (Berke et al., 2015; Berke et al., 2018; Malecha et al., 2018, 2021). Some key lessons from this research include the need to incorporate adaptation into existing processes (Bierbaum et al., 2013; Fu et al., 2017a; Preston et al., 2011; Tobey et al., 2010). Linkages between plans (Berke et al., 2015; Fu et al., 2017a; Keenan, 2018; Malecha et al., 2021), between climate change and disaster risk management (Djalante et al., 2011; Tang et al., 2013), and between government sectors (Baker et al., 2012) also needs to be improved. Key strategies to address uncertainty, such as scenario planning (Berke & Lyles, 2013; Butler et al., 2016; Tobey et al., 2010) and expanded adaptation policy toolkits (Fu et al., 2017a) need to be better employed. Lastly, evaluation is key to ensuring flexible and effective approaches to advance adaptation (Silva Villanueva, 2011).

b) Research Gaps

Although the research is growing, there are key opportunities to build on this research and fill apparent gaps and needs. For example, there has been a considerable amount of coastal governance research on broader programmatic elements and performance (Bernd-Cohen & Gordon, 1999; Ehler, 2003; Kearney et al., 2007; Lowry, 1985; Lowry et al., 1993, 2005), but few have evaluated the specific links to planning (Allmendinger et al., 2002) or the quality of plans (Tang, 2008) from a coastal governance perspective. This has also been the case in Hawaii, where studies have examined broad shoreline policy influences on erosion and beach loss (Abbott, 2013; Kittinger & Ayers, 2010; Summers et al., 2018), but have not evaluated local plans from this lens. Some have examined the links between coastal governance and adaptation (Falaleeva et al., 2011; O'Donnell, 2019; Tobey et al., 2010; Tol et al., 2008; Tribbia & Moser, 2008), but none through a planning or plan evaluation lens. As highlighted in

previous sections, there have been numerous plan evaluation studies related to various planning issues throughout the U.S. and elsewhere; however, there has been little to no plan evaluation research specific to island jurisdictions. There has been little plan evaluation research related to coastal management (Tang, 2008) or coastal adaptation (Butler et al., 2016; Fu et al., 2017a). Plan evaluation research is often based on the quantitative scoring of plans but is seldom accompanied by qualitative analysis providing context to plan scores. Few have employed a mixed-methods approach to evaluate both plan quality and processes related to adaptation (Baker et al., 2012; Butler et al., 2016; Wheeler, 2008; Woodruff, 2016; Woodruff et al., 2018), but none for coastal adaptation specifically. There is a need to further examine planning processes for adaptation (Berke & Lyles, 2013; Keenan, 2018), as well as the institutional constraints and barriers to adaptation (Baker et al., 2012; Bierbaum et al., 2013; Biesbroek et al., 2013; Eisenack et al., 2014), and how adaptation is integrated into existing planning processes (Bierbaum et al., 2013).

This dissertation research aims to fill the gaps identified above by examining the links between coastal governance and adaptation from a planning perspective, through both quantitative plan evaluation and qualitative assessment of planning context and processes. The study focuses on island jurisdictions in the U.S. (state/territory-level), areas which have received little planning research attention. The study will leverage established plan evaluation methods, modified to examine coastal adaptation planning progress and approaches among relevant plans. Accompanying this approach with interviews of coastal and planning practitioners will provide insight into the level of integration among plans as well as the processes and barriers to adaptation in island settings.

B. A Proposed Evaluation Framework for Coastal Adaptation Planning

1. Principles of Coastal Adaptation

The following section identifies the common organizing principles of coastal governance and adaptation, or coastal adaptation. Collectively, these principles serve as a lens to assess the capacity and effectiveness of planning in the study areas. The development of these principles draws from the coastal governance and adaptation literature, as well as plan quality research, customizing plan quality principles to specifically assess coastal adaptation planning. By assessing planning from this lens, lessons can be identified to improve existing planning mechanisms to achieve mutual objectives of coastal governance and adaptation – ultimately reducing vulnerabilities to climate impacts while preserving critical ecosystems and natural resources in island coastal communities.

a) Principles of Coastal Governance

The goals of coastal governance include the sustainable development of coastal areas, the reduction of vulnerability to hazards, and the preservation and restoration of ecological processes (Cicin-Sain et al., 1998). Coastal governance has settled on key approaches that guide the field, such as ecosystem-based management or ecosystem governance (Burroughs, 2011; Forst, 2009), community-based management (Christie & White, 1997), and adaptive management (Olsen, 2003). The sustainability

paradigm has also served to organize and motivate coastal governance (Duxbury & Dickinson, 2007; Kay & Alder, 2005; Marcucci et al., 2012). Indeed, much of the drive towards ICZM was founded on the principles of *sustainable development* and the recognition of the need to balance environmental, economic, and social systems in coastal areas while addressing intra- and inter-generational equity (Cicin-Sain et al., 1998). Within these approaches the key concepts of *participation* in the governance process, awareness of *socio-ecological interactions*, appreciation for *learning and flexibility*, and *integration* emerge as central tenets of coastal governance. *Integration* in particular is key to ICZM and refers to the horizontal and vertical integration of multiple levels of government, objectives, stakeholders, sectors, and sources of information into the decision-making process (Cicin-Sain et al., 1998; Marcucci et al., 2012; Post & Lundin, 1996; Sorensen, 1997). Because of the complexity of the coastal management political landscape and uncertainty of outcomes, *adaptive management* and its learning-based and incremental approaches are important elements of coastal governance (Burroughs, 2011; Forst, 2009; Kay & Alder, 2005; Olsen et al., 1997; Olsen, 2003).

Cicin-Sain et al. (1998) distinguish between two forms of participation – 'advice giving' (e.g., soliciting public comment on actions, public meetings) and "power sharing" (p. 238). Power sharing approaches the more ideal objectives of collaborative planning in defining problems and solutions collectively. 'Co-management' of coastal areas or resources exemplifies this approach (Cicin-Sain et al., 1998). Other processes and approaches that have been shown to foster meaningful participation include community-based management (Christie & White, 1997; Kearney et al., 2007), and ecosystem-based management (Forst, 2009). Forst (2009) argues that a 'bioregional planning' approach effectively addresses the cross-boundary, land-sea characteristics of coastal ecosystems and stakeholder groups. Stakeholders in coastal governance include planners, coastal managers, scientists, state and federal agencies, boundary institutions, property owners, recreational users, resource users, developers and coastal businesses (Mitsova & Esnard, 2012). Kay & Alder (2005) highlight that coastal stakeholders may also include those that may not use or reside at the coast, but still value it. The potential competition between interests and uses is apparent and demands consensus-building processes to manage potential conflict. Part of this process includes collaboratively establishing a common perspective or frame-setting (Alexander, 2000; Healey, 2006). In conceptualizing coastal planning from a socio-ecological perspective, (Lloyd et al., 2013) highlight how a constituency and collective view of coastal issues can be socially constructed. The socio-ecological perspective is often promoted for guiding coastal governance processes, especially in relation to resilience and hazards (Adger, 2005; Glavovic, 2008; Lloyd et al., 2013). Similar to ICZM, socio-ecological resilience literature points to multi-level and polycentric governance, recognition of ecosystem boundaries and land-sea interactions, and an adaptive learning-based approach to increase resilience (Adger, 2005; Doberstein et al., 2019; Lloyd et al., 2013). A consolidated list summarizing the central principles described above that guide coastal governance is provided in Table 2 below.

Table 2 – Principles of Coastal Governance

Principle	Objective	Sources
Integration	Horizontal/vertical integration between sectors and levels of government	*(Allmendinger et al., 2002; Cicin-Sain et al., 1998; Duxbury & Dickinson, 2007; Kay & Alder, 2005; Marcucci et al., 2012; Sorensen, 1997)*
Participation	Participatory processes in coastal decision-making, inclusive of diverse set of stakeholders.	*(Beatley, 2012; Cicin-Sain et al., 1998; Doberstein et al., 2019; Duxbury & Dickinson, 2007; Kay & Alder, 2005; Olsen et al., 1997)*
Science-based	Integration of multi-disciplinary scientific information into decision-making	*(Allmendinger et al., 2002; Cicin-Sain et al., 1998; Sorensen, 1997)*
Land-sea perspective	Governance cognizant of cross-boundary coastal processes and ecosystems	*(Adger, 2005; Allmendinger et al., 2002; Cicin-Sain et al., 1998; Doberstein et al., 2019; Forst, 2009; Lloyd et al., 2013; Sorensen, 1997)*
Adaptive management	Learning-based, flexible approach which include monitoring and evaluation of progress and adjustments as needed.	*(Adger, 2005; Doberstein et al., 2019; Duxbury & Dickinson, 2007; Kay & Alder, 2005; Lloyd et al., 2013; Olsen et al., 1997)*

b) Principles of Adaptation

Since adaptation is an adjustment of a system as a function of its vulnerability to climate impacts (IPCC, 2022), the overarching goal and guiding principle of climate adaptation is the reduction of vulnerability (Brooks, 2003; Fussel, 2007b). There are several other principles offered in the literature to facilitate adaptation and the reduction of vulnerability to climate impacts. Some offer principles in the context of assessing adaptation actions (Adger et al., 2005; Pringle, 2011), to include *effectiveness*, *efficiency*, *equity*, and *legitimacy* (Adger et al., 2005). The principles are context-specific, as the importance of these principles varies across scales, sectors, actors, and over time; therefore, tradeoffs among principles are inevitable based on community priorities. Equity, efficiency, and legitimacy relate to participation and raise the issue of justice in climate change in terms of the outcomes, the distribution of costs/benefits, and the fairness of process – important considerations for the long-term success and sustainability of adaptation. Pringle (2011) also suggests *sustainability*, *integration*, and *participation*, in addition to effectiveness, efficiency, and equity as principles of 'good' adaptation.

Guiding principles have been offered in the specific context of adaptation planning (Berke & Lyles, 2013; Berke & Stevens, 2016; Butler et al., 2016; Fussel, 2007a; Hurlimann et al., 2014; Woodruff, 2016). Hurlimann et al. (2014) highlight three criteria for successful adaptation planning – facilitating *local ownership* of adaptation, developing *collective forms of action*, and ensuring *fairness* across space and

time. Inherent among these criteria is the importance of equity and collaboration among levels of government and those communities that adaptation serves. *Equity* is an important consideration in terms of focusing adaptation on the most vulnerable populations, ensuring adaptation actions don't increase the vulnerability of others, and providing access and meaningful participation in adaptation planning processes (Douglas et al., 2012; Meerow et al., 2019; Siders, 2019b). *Participation* in adaptation decision-making processes helps to ensure more equitable responses and is another guiding principle for adaptation planning (Berke & Lyles, 2013; Berke & Stevens, 2016; Meerow & Woodruff, 2020). Other key considerations for adaptation planning include robust planning intelligence based on credible climate information (Berke & Stevens, 2016; Butler et al., 2016; Meerow & Woodruff, 2020; Moser et al., 2012; Tribbia & Moser, 2008); *learning* through evaluation and monitoring (Butler et al., 2016; Meerow & Woodruff, 2020; Woodruff, 2016), and *collaboration* and coordination among diverse sectors, communities, and levels of government (Berke & Lyles, 2013; Hurlimann et al., 2014; Meerow & Woodruff, 2020). A consolidated list summarizing the central principles described above that guide adaptation planning is provided in Table 3 below.

Table 3 – Principles of Adaptation Planning

Principle	Objective	Sources
Reducing vulnerability	Reduce the vulnerability of human and natural systems to the impacts of climate change	(Brooks, 2003; Fussel, 2007b)
Equity and Participation	Meaningful participation in planning processes of all those impacted by adaptation actions to ensure both equitable processes and outcomes	(Adger et al., 2005; Berke & Lyles, 2013; Berke & Stevens, 2016; Hurlimann et al., 2014; Meerow et al., 2019; Meerow & Woodruff, 2020; Pringle, 2011; Siders, 2019b)
Planning intelligence	Sound planning fact base grounded on latest climate science and risk information	*(Berke & Stevens, 2016; Butler et al., 2016; Meerow & Woodruff, 2020)*
Collaboration and coordination	Collaborative adaptation planning processes coordinated across communities, sectors, and levels of government	*(Berke & Lyles, 2013; Hurlimann et al., 2014; Meerow & Woodruff, 2020)*
Adaptive management	Learning-based adaptation characterized by flexible policies and strategies that address uncertainty	*(Butler et al., 2016; Meerow & Woodruff, 2020; Woodruff, 2016)*

c) A Consolidated Set of Principles for Coastal Adaptation Planning

Many of these adaptation principles resemble those of coastal governance. Some have highlighted the overlap and connections between coastal management and adaptation (Falaleeva et al., 2011; Moser et al., 2012; Tobey et al., 2010; Tol et al., 2008; Tribbia & Moser, 2008), as many of the

challenges of coastal management are exacerbated by climate change. Moser et al. (2012) frame the climate challenges along the coast as a wicked problem (Rittel & Webber, 1973) due to the combining stresses of human pressures and coastal degradation in addition to the uncertain changes in coastal dynamics. Many coastal management approaches and principles are applicable to adaptation, but there is a need for strengthening coastal governance structures and approaches to advance coastal adaptation (Falaleeva et al., 2011; Moser et al., 2012; Tol et al., 2008). This includes prioritizing an adaptive coastal management approach, strengthening the science-to-practice connection through credible information, prioritizing nature-based coastal adaptation, considering a longer-planning horizon, and addressing uncertainty (Moser et al., 2012; Tobey et al., 2010; Tribbia & Moser, 2008). Fussell (2007b) highlights uncertainty as a unique consideration for adaptation planning. Although uncertainty is often overlooked in planning (Woodruff, 2016), it is an important consideration for coastal adaptation. Berke and Lyles (2013) propose a new model for planning to address uncertain climate risks, combining collaborative governance approaches of social learning through dialogue and expanded networks, with anticipatory governance approaches of recognizing multiple possible futures and evaluative and iterative decision-making. Scenario planning for potential futures is a tool for addressing uncertainty in adaptation (Berke & Lyles, 2013; Butler et al., 2016; Moser et al., 2012; Spirandelli et al., 2016; Tobey et al., 2010; Woodruff, 2016). These strategies relate to the adaptive management approaches of employing flexible policies and institutionalizing learning in the adaptation process (Butler et al., 2016; Moser et al., 2012; Tol et al., 2008). Table 4 below highlights the connections between coastal governance and adaptation through a merged set of principles for coastal adaptation planning, which can serve as a lens for evaluation.

Table 4 – Coastal Adaptation Planning Principles

Principle	Objective	Sources
Adaptation intelligence	Sound planning fact base grounded on latest climate science and risk information related to coastal changes and vulnerability	*(Allmendinger et al., 2002; Berke & Stevens, 2016; Butler et al., 2016; Meerow & Woodruff, 2020; Moser et al., 2012; Tribbia & Moser, 2008)*
Inclusive planning	Meaningful participation in planning processes of all those impacted by coastal adaptation actions to ensure both equitable processes and outcomes	(Adger et al., 2005; Beatley, 2012; Berke & Lyles, 2013; Berke & Stevens, 2016; Doberstein et al., 2019; Duxbury & Dickinson, 2007; Hurlimann et al., 2014; Meerow et al., 2019; Meerow & Woodruff, 2020; Pringle, 2011; Siders, 2019b)
Integrated planning	Coastal adaptation that is integrated within and across sectors, levels of government, and planning mechanisms	*(Allmendinger et al., 2002; Berke & Lyles, 2013; Berke & Stevens, 2016; Cicin-Sain et al., 1998; Duxbury & Dickinson, 2007; Kay & Alder, 2005; Marcucci et al., 2012; Meerow & Woodruff, 2020; Sorensen, 1997)*
Vulnerability reduction	Reduce the vulnerability of coastal systems, both human and natural, to the impacts of climate change	(Brooks, 2003; Fussel, 2007b; Tol et al., 2008)
Nature-based adaptation	Adaptation which considers the land-sea connections, recognizes cross-boundary coastal processes and ecosystems, and prioritizes nature-based solutions	*(Adger, 2005; Allmendinger et al., 2002; Cicin-Sain et al., 1998; Doberstein et al., 2019; Forst, 2009; Lloyd et al., 2013; Moser et al., 2012; Sorensen, 1997; Tobey et al., 2010)*
Adaptive planning	Learning-based planning characterized by measurable goals/objectives, flexible policies and strategies that address uncertainty, monitoring/evaluation, and adjustment if necessary.	*(Adger, 2005; Berke & Lyles, 2013; Butler et al., 2016; Doberstein et al., 2019; Duxbury & Dickinson, 2007; Kay & Alder, 2005; Lloyd et al., 2013; Meerow & Woodruff, 2020; Moser et al., 2012; Olsen et al., 1997; Tobey et al., 2010; Tol et al., 2008; Woodruff, 2016)*

2. A Coastal Adaptation Planning Evaluation Framework

The literature highlights the importance of planning for facilitating coastal management (Allmendinger et al., 2002; Tang, 2008) and adaptation (Fu et al., 2017a; Hurlimann et al., 2014; Lyles et al., 2018) efforts, both through planning products and policies, as well as established participatory planning processes (Berke & Stevens, 2016). The ability of planning to facilitate success in these arenas is driven by planning context and the interaction between levels of government and among planning sectors (Allmendinger et al., 2002; Hurlimann et al., 2014; Macintosh, 2013). Plan evaluation research has employed various approaches tailored to assess specific planning issues (Lyles & Stevens, 2014). Lyles et al. (2014) employ a useful framework in their evaluation of hazard mitigation plans in the U.S. They organize their evaluation under three planning aspects: planning *outputs*, planning *processes*, and planning *context*. This framework, along with the principles above, serves as a useful lens to evaluate coastal adaptation planning.

Planning *outputs* refer to the products or results of planning, namely plans and policies; planning *processes* are the actions taken by planners and other stakeholders "to develop and implement planning outputs"; and planning *context* refers to the "conditions under which planning processes take place"(Lyles et al., 2014). Researchers have evaluated the quality of planning outputs or plans from diverse perspectives, assessing plans against plan quality principles or the characteristics of the policies within them (Lyles et al., 2014; Lyles & Stevens, 2014). Recently the integration among plans, rather than the quality of individual plans, has been the subject of research (Berke et al., 2015; Lyles et al., 2018). As noted in the above principles, integration is key to both coastal management and adaptation. Evaluating planning outputs provides an opportunity to examine this integration as well as the types of policy tools within plans that affect vulnerability (Berke et al., 2015; Butler et al., 2016; Fu et al., 2017a; Lyles et al., 2018; Tang, 2008) and advance priorities for nature-based adaptation (Tobey et al., 2010). Studies of coastal management and adaptation processes have included examining those involved in planning and the type of participation (Hurlimann et al., 2014; Keenan, 2018; Lyles et al., 2014; Lyles et al., 2018; Preston et al., 2011; Tang, 2008), the information needed and used for adaptation planning especially with respect to climate risk and vulnerability (Fu et al., 2017a; Macintosh, 2013; Preston et al., 2011; Tang, 2008; Tribbia & Moser, 2008), and the adaptiveness of planning in terms of flexibility of policies and commitment to learning (Butler et al., 2016; Macintosh, 2013; Preston et al., 2011; Woodruff, 2016). Many have looked at the contextual influences on planning responses, including the governance structures and frameworks under which coastal adaptation decisions take place (Allmendinger et al., 2002; Hurlimann et al., 2014; Macintosh, 2013; Measham et al., 2011; Shi et al., 2015), local adaptation progress (Baker et al., 2012; Butler et al., 2016; Shi et al., 2015; Tang et al., 2010, 2013), and the influence of recent climate impacts or disasters (Butler et al., 2016; Lyles et al., 2014; Shi et al., 2015). Evaluating the proposed coastal adaptation principles under these three planning dimensions – *outputs*, *processes*, and *context* – can underscore potential barriers and challenges to coastal adaptation and highlight potential best

practices and improvements. Combining this approach with the coastal adaptation principles yields a conceptual framework for evaluating coastal adaptation planning, shown in Figure 1 below.

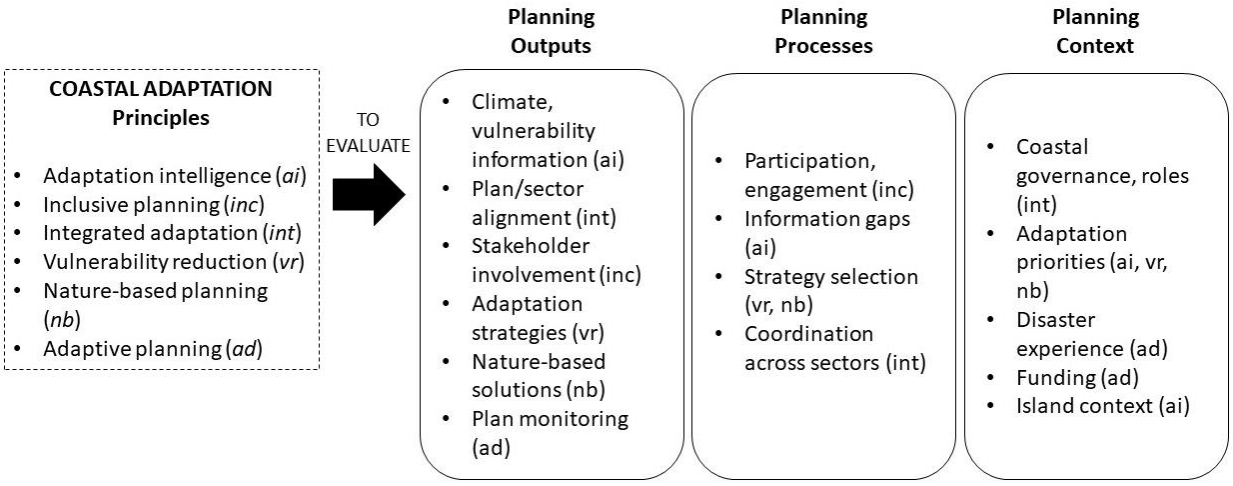

Figure 1. Conceptual framework for coastal adaptation planning evaluation

3. Applying the Framework – Potential Methods and Applications

The ideals of coastal management and adaptation call for an integrated approach in which objectives and considerations of coastal management and adaptation permeate across and within a community's planning and governance systems. The proposed research questions serve to assess this integration, as well as to gauge adaptation progress and planning challenges in island jurisdictions in the U.S. The analytical framework proposed above provides an organized approach for that assessment, focused on examining the planning outputs, processes, and context against a set of coastal adaptation principles. The framework does not prescribe the methods of the evaluation – whether quantitative or qualitative; however, there are examples of mixed-methods studies that leverage a variety of approaches and data sources to look at planning outputs, processes, and context related to adaptation (Baker et al., 2012; Butler et al., 2016). These types of mixed-methods approaches may provide insights into the products, processes, and context of adaptation planning where a single method may not.

This dissertation research applies this framework through a similar mixed methods evaluation with a focus on islands, where coastal adaptation is both necessary and challenging. The research consists of two stand-alone but complementary studies – both across U.S. Island jurisdictions (American Samoa, Commonwealth of the Northern Mariana Islands, Guam, Hawaii, Puerto Rico, U.S. Virgin Islands). The first study quantitatively evaluates adaptation-relevant plans that are common across the jurisdictions, while the second leverages qualitative analysis of interviews with practitioners to highlight processes, challenges and best practices related to adaptation. Combined these studies evaluate each of the coastal adaptation planning principles (*adaptation intelligence, inclusive planning, integrated planning,*

vulnerability reduction, nature-based adaptation, adaptive planning) across the three planning dimensions (*outputs, processes, context*), as shown in Figure 2 below. The plan evaluation focuses on planning outputs (adaptation-relevant plans) and the processes outlined in plans, while interviews with practitioners provide more depth into planning processes and context.

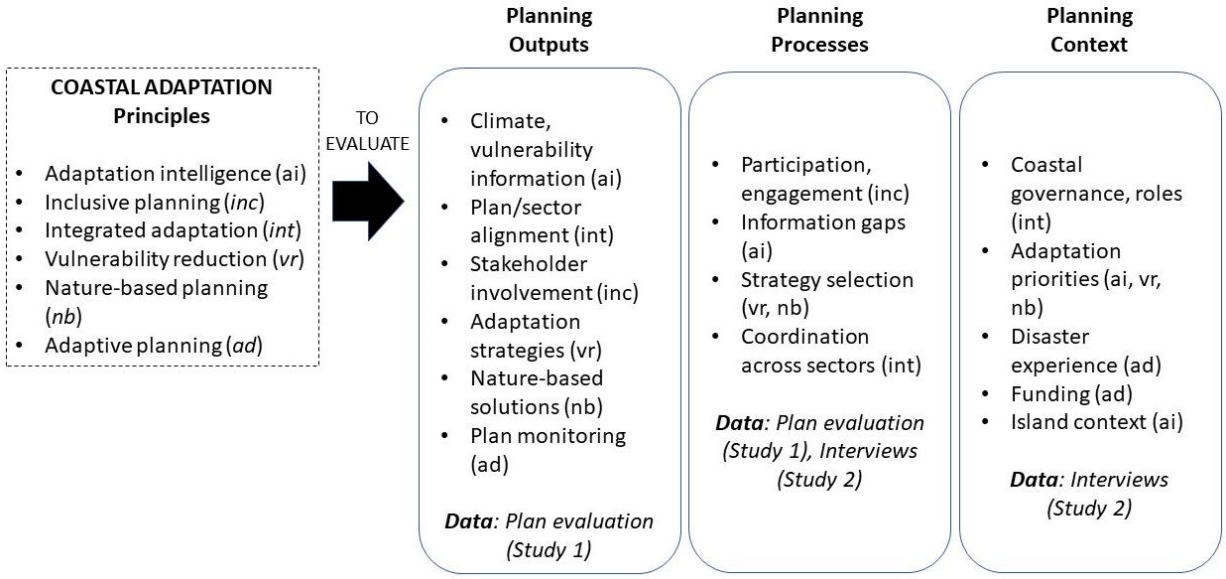

Figure 2. Coastal Adaptation Planning Evaluation Framework applied with data sources.

Although applied here to this cross-sectional island context, this framework can be applied to any setting in which evaluating coastal adaptation planning is either necessary or beneficial – either for research or practice. Applying it in a similar fashion longitudinally may provide insights into how plans and processes move towards adaptation over time as new information and strategies become available and priorities and tradeoffs shift. Jurisdictions embarking on new planning efforts or plan updates may find this evaluation framework useful to gauge how current plans have achieved adaptation objectives and what subsequent plans should include and who has been left out of the process. The principles and their indicators can be customized for other coastal settings based on community priorities and specific challenges. Ultimately, the framework, however applied, is not a prescription but a foundation from which to embark on an evaluative process rooted in the quest to learn – to learn how well we've done so that we can adapt to whatever comes in the future.

CHAPTER 3. AN EVALUATION OF ADAPTATION-RELEVANT PLANS IN U.S. ISLAND JURISDICTIONS

A. Background

As the risks associated with climate change have become more evident and inevitable (IPCC, 2021), the need for adaptation has become apparent (IPCC, 2022). In coastal communities, sea level rise will exacerbate chronic hazards such as flooding and erosion, while the combination of sea level rise and intensifying storms is a looming threat. This risk looms large over tropical islands, areas most vulnerable to sea level rise (Hooijer & Vernimmen, 2021) and with little room to move existing development and infrastructure that is already exposed to surrounding ocean hazards. U.S. island jurisdictions – American Samoa, Commonwealth of the Northern Mariana Islands (CNMI), Guam, Hawaii, Puerto Rico, U.S. Virgin Islands – are no different, as their location in the tropics place them in the crosshairs of both sea level rise and tropical cyclones, in addition to other climate risks such as drought, extreme precipitation, and ocean acidification (Reidmiller et al., 2018). The recognition of adaptation's importance has grown in recent years (IPCC, 2022), however adaptation planning is in early stages (Bierbaum et al., 2013; Miao, 2019), with implementation just beginning (Olazabal et al., 2019). Adaptation planning in the U.S. has grown at the local level (Shi et al., 2015), but few adaptation plans have been adopted at the state level (Miao, 2019). This is the case across U.S. Island jurisdictions which operate at the state (Hawaii) or territory/commonwealth-level (Guam, American Samoa, US Virgin Islands, Puerto Rico, CNMI). Although there are currently no state/territory/commonwealth-level adaptation plans across U.S. islands, climate change is very much a priority for the islands and adaptation planning efforts are manifesting in other ways (Díaz et al., 2018; Keener et al., 2018).

Adaptation planning does not require a separate planning document dedicated to climate change adaptation. Jurisdictions have the option of addressing adaptation through dedicated plans, or through existing planning mechanisms Lyles et al., 2018). Some adaptation approaches and considerations are inherent to other planning domains (Bedsworth & Hanak, 2010; Fussel, 2007a), including coastal management (Moser et al., 2012; Tobey et al., 2010; Tribbia & Moser, 2008), hazard mitigation (Berke & Lyles, 2013; Blanco et al., 2009; Lyles et al., 2018) and planning (Berke & Stevens, 2016; Blanco et al., 2009; Hurlimann et al., 2014). As such, adaptation may be supported by or incorporated into coastal plans, hazard mitigation plans, or comprehensive plans (Bedsworth & Hanak, 2010; Fu et al., 2017a; Lyles et al., 2018). Planning considerations that are unique to adaptation include the uncertainty of future climate impacts and vulnerability, the need to consider a longer time-horizon, the need for credible climate information, the role of natural systems, and the need to expand stakeholder engagement and interagency coordination to address cross-jurisdictional and cross-sectoral impacts (Bedsworth & Hanak, 2010; Berke & Lyles, 2013; Moser et al., 2012; Tobey et al., 2010). Evaluating existing planning mechanisms for their incorporation of these and other adaptation objectives may provide insight into their

effectiveness and potential to serve as adaptation planning tools, especially on islands. This study evaluates adaptation-relevant plans in U.S. Island jurisdictions using established quantitative plan evaluation methods.

B. Literature Review – Plan Evaluation Research Relevant to Coastal Adaptation

1. Plan Quality Evaluation

As discussed in Chapter 2, there is a robust body of literature on plan evaluation, and specifically plan quality evaluation, with evaluations conducted under a variety of planning lenses (Lyles & Stevens, 2014). Plan quality evaluation research typically draws on content analysis approaches to systematically review planning documents according to a prescribed set of criteria or principles (Berke & Godschalk, 2009; Connell & Daoust-Filiatrault, 2017; Lyles & Stevens, 2014; Norton, 2008). Although much of plan quality work has converged on a set of principles to measure plan quality – *goals*, *fact base*, *policies*, *interorganizational coordination*, and *implementation & monitoring* – these principles can be replaced, modified or tailored depending on the research question or planning interest (Lyles & Stevens, 2014). Although plan quality evaluation has been conducted under myriad planning interests (see Chapter 2.A.3.c), the following review focuses on studies that have used content analysis procedures to assess plan quality from those perspectives relevant to adapting to coastal climate impacts – namely climate adaptation, coastal management, and hazard mitigation planning.

2. Adaptation Plan Quality

There have been a number of plan evaluation studies examining the quality of climate change-specific plans at the local level, whether climate action plans (Tang et al., 2010), local land use and hazard mitigation plans and policies to address sea level rise (Butler et al., 2016; Fu et al., 2017a), or local adaptation and resilience plans (Baker et al., 2012; Guyadeen et al., 2019; Lyles et al., 2018; Reckien et al., 2023; Woodruff, 2016; Woodruff et al., 2018). Fewer have assessed climate change plans at various scales (Olazabal et al., 2019; Preston et al., 2011) or at the state-level specifically (Tang et al., 2013). Regardless of scale or type of plan, these studies employ similar systematic approaches to evaluate plans, albeit with tailored evaluative criteria. For example, Tang et al. (2010, 2013) use an *Awareness-Analysis-Action (AAA)* framework representing key stages of adaptation planning to assess the quality of climate action plans, finding local climate action plan quality to be higher in the earlier stages of adaptation with state-level mandates having the most significant influence on plan quality (Tang et al., 2010). State climate action plans were found to vary widely in their management of coastal disaster risk, with medium quality overall and no contextual variables showing a significant relationship to plan quality (Tang et al., 2013). Preston et al. (2011) also use an evaluation framework based on adaptation planning stages – *goal-setting*, *stock-taking*, *decision-making*, and *implementation & evaluation* – to evaluate 57 adaptation plans from various jurisdictions in the U.S., U.K, and Australia, finding that adaptation plans are lacking in quality and that jurisdictions prefer lower-risk '*building adaptive capacity*' strategies over those that '*deliver adaptation actions'*. Fu et al. (2017) leverage established plan quality

criteria – *fact base, goals, coordination, policies & strategies, and implementation* – to gauge how cities in the U.S. are addressing sea level rise in comprehensive plans and hazard mitigation plans, asserting that these plans are the most suitable mechanisms for addressing SLR due to their holistic lenses, their continuous planning processes, their existing collaboration procedures, and the fact that sea level rise affects both development and hazards (Fu et al., 2017a). Fu et al. (2017) find that plan quality varied widely across the sample cities with the best plans having high levels of local leadership and state support.

3. Adaptation Plan Evaluation as Part of a Mixed Methods Approach

Plan evaluation approaches may be one component of a mixed methods planning assessment. Augmented by semi-structured interviews to identify barriers, Baker et al. (2012) quantitatively assess the progress and quality of 7 local adaptation plans in Australia using both the Awareness-Analysis-Action framework (Tang et al., 2010, 2013) and plan quality components (Fu et al., 2017a). Baker et al. (2012) find that the evaluated plans were deficient in both adaptation progress and plan quality, with the most significant barriers being the lack of integration of adaptation across government sectors, lack of participatory processes, and the lack of locally scaled climate information. Butler et al. (2016) use an evaluation framework based on an adaptive risk management approach and the rational planning model – *goals & objectives, planning intelligence, land use policies & strategies, monitoring & evaluation* – to evaluate sea-level rise adaptation progress of forty-two coastal counties in Florida. Butler et al. (2016) augment their study with semi-structured interviews of practitioners, finding that adaptation progress has been incremental, with a preference towards low-regrets actions such as assessments and nonbinding policies. This is driven by concerns about over-adaptation and uncertainty of climate information, although more credible information and direct experience with sea level rise impacts may influence more progressive action (Butler et al., 2016). Augmented by practitioner interviews, Woodruff et al. (2016) examine local adaptation plans using established plan quality principles while adding an 'uncertainty' principle to assess the integration of strategies that address uncertainty in local adaptation plans, finding that plans are low in overall quality and do not affectively address uncertainty.

4. Evaluating Plan Integration for Adaptation

Integration has been a common interest among plan evaluation research, either as part of the 'coordination' plan quality measure, the degree to which land use or other policies are integrated into plans, or the integration and alignment among a network of plans. Lyles et al. (2018) quantitatively assess the integration between adaptation plans and *adaptation-supportive* plans (e.g., transportation plans, open space plans, emergency operations plans, etc.). Using content analysis procedures Lyles et al. (2018) evaluate whether references to other plans are made in each adaptation plan, whether land use policies are included in adaptation plans, and whether planning agencies are involved in developing adaptation plans. Findings show that narrow-scope plans targeting specific climate risks integrate adaptation-supportive plans better than broader community plans (e.g. comprehensive plans), narrow-

scope plans tend to include more land use tools reducing exposure to hazards, and planning agency involvement results in more integration across plans (Lyles et al., 2018). In line with these findings, Preston et al. (2011) suggest that adaptation planning can be improved through its integration with other urban and disaster planning efforts and the use of participatory approaches; Fu et al. (2017) suggest that stronger connections between comprehensive plans and hazard mitigation plans can help advance adaptation to sea level rise; and Tang et al. (2013) identified areas requiring stronger connections to coastal climate risk management, such as the use of shoreline regulations and integration with coastal management plans and hazard mitigation plans.

5. Evaluating Coastal Management and Hazard Mitigation Plans

These two plans in particular – coastal management plans and hazard mitigation plans – are especially relevant to adaptation in coastal and island settings and plan evaluation researchers have examined both, although not often in the specific context of climate adaptation (Fu et al., 2017a; Matos et al., 2022). The connections between coastal management and other forms of planning have been highlighted by many (see Ch. II.A), but few have invoked plan quality approaches to coastal management (Tang, 2008). Tang (2008) evaluated the quality of coastal land use plans in California using a quantitative assessment of plan quality criteria – *fact base, goals and objectives, policies, inter-organizational coordination, and implementation and monitoring* – and coastal zone management objectives. In doing so, Tang (2008) associates land use planning with coastal management and argues that the quality of a land use plan reflects the "collaborative vision for coastal zone management" (p. 545). Tang (2008) finds that the quality of coastal land use plans is improved by the number of planners and integrating coastal management efforts. In contrast to coastal plan evaluation, hazard mitigation plans have often been the object of plan quality studies (Berke et al., 2012; Berke et al., 2014; Fu et al., 2017a; Horney et al., 2017a; Lyles et al., 2014). Findings suggest that the quality of hazard mitigation plans have generally been low (Berke et al., 2012; Fu et al., 2017a; Horney et al., 2017a; Lyles et al., 2014), especially in rural settings (Horney et al., 2017a); while they rarely incorporate land use policy approaches in the plans (Horney et al., 2017; Lyles et al., 2014), or land use planners in the planning process (Lyles et al., 2014), both of which can affect plan quality. Other factors affecting hazard mitigation plan quality may include experience with previous disasters, the federal-state-local policy context, the perceived mitigation role of the emergency management agency, and the presence of local advocates for hazard mitigation and risk reduction (Berke et al., 2012; Berke et al., 2014).

These findings suggest that there is room for improvement in not only the quality of plans and the types of policies they include, but also in the integration across plans and the involvement of other sectors in the planning processes associated with climate adaptation, coastal management, and hazard mitigation. They also highlight a few research gaps that this study addresses: the evaluation of coastal management and hazard mitigation plans in the context of climate adaptation, the evaluation of these plans at the state-level, and evaluation of these types of plans on islands in particular.

C. Methods and Data

1. Principles and Indicators

This study aims to address research question #2: *How well do island plans integrate coastal adaptation principles?* This evaluation draws on the *Coastal Adaptation Planning Evaluation Framework* outlined in Ch.II.B.2. This framework organizes the evaluation under the three planning dimensions – outputs, processes, and context – while evaluating plans against the coastal adaptation planning principles. This study primarily focuses on the 'outputs' (plans) dimension and the 'processes' to the extent they are described in the plans as shown in Figure 3 below. Planning context, although important and considered, is more closely investigated in Study 2.

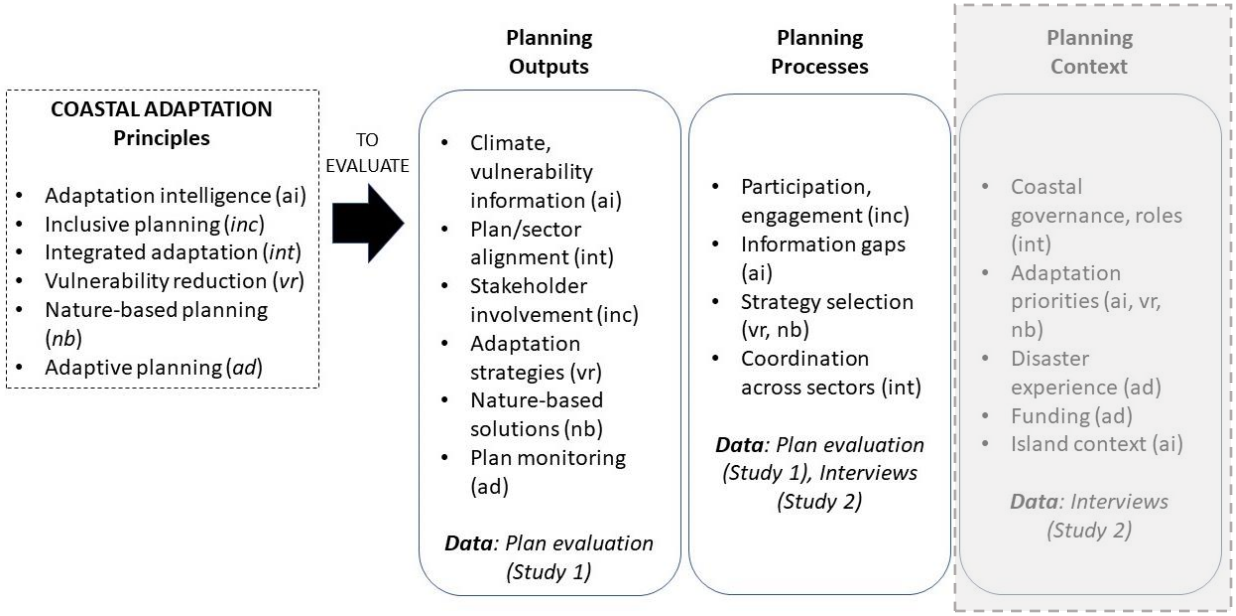

Figure 3: Evaluation framework indicating focus of the plan evaluation study.

The indicators for each principle were identified from similar plan evaluation studies that were focused on plans intended to reduce vulnerability to climate risks and hazards – adaptation planning (Butler et al., 2016; Fu et al., 2017a; Lyles et al., 2018; Woodruff, 2016; Woodruff & Stults, 2016), coastal planning (Tang, 2008), and hazard mitigation planning (Berke et al., 2012; Horney et al., 2017a; Lyles et al., 2014; Lyles et al., 2014) – focusing on those indicators that are especially important for island and coastal settings. Indicators in each principle were categorized to organize types of indicators and allow for further level of analysis if desired. ***Adaptation Intelligence*** was devolved into *current conditions* and *future conditions*, similar to Woodruff and Stults (2016), while including indicators for pertinent coastal information, such as shoreline change rates, wetland/beach/reef conditions, sea level rise projections, etc. (Fu et al., 2017a; Tang, 2008). ***Inclusive Planning*** is divided between indicators related to *planning process* and those related to *equity*. Under the often-used plan quality component of *Participation*, many

have assessed indicators related to stakeholder engagement in the planning process. The *Inclusive Planning* principle differs slightly in that it is interested in not only planning processes, but also how plans affect equity and those that are often not considered in planning processes. Many have included indicators to identify vulnerable populations under the *Fact Base* plan quality principle, but few have included indicators specific to how vulnerable, marginalized, or underserved communities are included in the planning process (Woodruff & Stults, 2016). This study builds on Woodruff and Stults (2016) by adding an indicator assessing not only if underserved communities are included in the process, but if strategies are identified that specifically target the risk of these communities. ***Integrated Planning*** includes indicators related to references to other plans (Lyles et al., 2014, 2018; Matos et al., 2022) and whether planners from other sectors were involved in the process (Berke et al., 2014; Lyles et al., 2014), ensuring that the plan integrates practitioners with roles in coastal adaptation. Much of the plan evaluation work that assesses involvement, has looked at whether land use planners were involved in adaptation plans (Lyles et al., 2018; Matos et al., 2022) or hazard mitigation plans (Berke et al., 2014; Lyles et al., 2014; Matos et al., 2022). This study adds indicators for the involvement of coastal managers and hazard mitigation planners, both of which have roles in adaptation planning in island jurisdictions. ***Vulnerability Reduction*** includes those policies and strategies intended to reduce vulnerability or adapt to coastal hazards. For this principle, indicators were divided into the common adaptation strategy categories of Protect, Accommodate and Retreat (Klein et al., 2001; Tol et al., 2008). *Avoid* is separated from *Retreat* to distinguish between strategies meant to prevent new development in hazardous areas (avoid) versus relocating existing development (retreat) (Butler et al., 2016; Doberstein et al., 2019). Planning and capacity-building strategies which aim to further understand vulnerability or hazards are also included in this principle. ***Nature-Based Adaptation*** indicators include those that leverage *regulations* or policies to protect ecosystems as well as *actions* that either leverage nature-based solutions or aim to further understand opportunities for nature-based solutions. Finally, ***Adaptive Planning*** combines the plan quality principles of *Goals/Objectives*, *Implementation*, and *Monitoring/Evaluation* often used in other studies, since adaptive planning is an iterative process across all of these stages. *Uncertainty/Adaptive Actions* is added as a measure of the use of flexible strategies to address the uncertainty of climate change and learn from disaster experience (Woodruff, 2016; Woodruff & Stults, 2016).

The six principles are grouped based on whether they are *informative* (adaptation intelligence, inclusive planning, integrated planning) or *responsive* (vulnerability reduction, nature-based adaptation, adaptive planning). Similar to *direction-setting* principles and *action-oriented* principles, as classified by others (Berke et al., 2014; Horney et al., 2017b), the principles are grouped based on whether they inform the strategies and actions in the plan, or if they generally are a response to information gathered through data collection, stakeholder participation, and integration with other sectors and plans. The groupings deviate from previous classifications, to convey the intent of the principles more simply. Also, the groupings in this case are not necessarily exclusive, since planning is intended to be a continuous, iterative process. *Adaptive Planning*, for example, includes goals and objectives (which are considered

direction-setting by others) which are informative in the sense that they inform the strategies; however, the goals and objectives should also be a response to the priorities identified through the adaptation intelligence, inclusive planning, and integrated planning principles. Instead, the groupings are meant to help organize the principles and indicators for analysis purposes, but also to convey that planning should be responsive to information – i.e. 'knowledge to action' (Friedmann, 1987). A full list of indicators is provided in Appendix A, while a sample list of indicators is shown in Table 5 below.

Table 5 - Coastal Adaptation Principles and Sample Indicators

Principle	No. of Indicators	Sample Indicators
INFORMATIVE PRINCIPLES		
Adaptation intelligence	21	**Current Conditions:** population trends, ecosystem conditions, shoreline change, current hazards **Future Conditions**: sea level rise projections, climate change hazards, vulnerable ecosystems/population/structures
Inclusive planning	11	**Planning Process:** plan describes process, stakeholders involved listed, public meetings/surveys/comment period **Equity:** engages underserved communities in planning process, includes strategies to address vulnerability in underserved communities
Integrated planning	9	**Refers to other plans**: hazard mitigation plan, coastal management plan, land use/comprehensive plan, disaster recovery plan, calls for plan alignment **Involves other sectors**: hazard mitigation planners, coastal managers, land use planners
RESPONSIVE PRINCIPLES		
Vulnerability reduction	33	**Avoid**: zoning, permitting, setbacks, land acquisition **Retreat**: relocation, structural acquisition **Protect**: shoreline armoring, flood protection structures **Accommodate**: elevation, retrofits, building codes **Planning/capacity-building**: new plans/assessments/studies, education, staffing, decision-support tools, technical guidance
Nature-based adaptation	12	**Regulations**: dune/wetland/reef protection, shoreline armoring restrictions, conservation zoning **Actions**: wetland/reef/beach restoration, living shoreline projects, green infrastructure, planning/studies
Adaptive planning	18	**Goals/Objectives**: includes goals, objectives, refers to adaptation **Implementation**: includes timetable, funding sources, responsible agencies **Monitoring/Evaluation**: describes plan monitoring and update mechanism, reviews previous plan progress **Uncertainty**: scenario planning, no-/low-regrets strategies, adaptation pathways

2. Sampling

a) Inventory of Island Plans

Plan samples were identified by first compiling an inventory of adaptation-relevant plans in each of the six jurisdictions (USVI, Puerto Rico, American Samoa, Hawaii, CNMI, Guam) to get a sense of the planning landscape across the islands. None of the jurisdictions have a completed state or territory-level adaptation plan, therefore plans that were relevant to coastal adaptation were sought and identified through public web searches, government websites, and discussions with practitioners that work or have worked in the islands. This inventory included a wide range of types and number of plans across the jurisdictions. These included economic development plans, hazard mitigation plans, transportation plans, watershed plans, and coastal management plans and policies among others. Jurisdictional arrangements and planning authorities vary across the jurisdictions – some jurisdictions include local-level units of government with planning authority (Hawaii, Puerto Rico) while in others the territory/common-wealth is the lowest level of government (USVI, American Samoa, CNMI, Guam). Because of this, some plans, such as land use or adaptation plans, exist at the local level but not at the state or territory level. None of the jurisdictions have a state/territory-level land use plan. Though not a plan, Hawaii has a state land use law which classifies all land at the state level into four categories: conservation, agriculture, urban and rural.

b) Two Common Plans: CZMA 309 Assessment & Strategy, Hazard Mitigation Plan

To facilitate comparative analysis between jurisdictions, it was important that selected plans be common across all of the jurisdictions, while being relevant to coastal adaptation. Two plans were identified that fit these criteria: the *Coastal Zone Management Act (CZMA) Section 309 Assessment & Strategy*, and the *State/Territory Hazard Mitigation Plan* as shown in Table 6. In addition to being common across jurisdictions and relevant to adaptation, these plans are incentivized by federal planning and funding programs, whereas approved plans provide access to federal funds that may be leveraged for adaptation. The CZMA Section 309 Enhancement Program, managed by the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management, incentivizes state coastal management programs to regularly assess their programs under nine enhancement areas: *public access, wetlands, coastal hazards, ocean and marine resources, government facility siting, cumulative and secondary impacts, aquaculture, marine debris* and *special area management planning* (NOAA, 2019). Based on the internal assessment, programs identify strategies to make program improvements in priority areas. By completing and getting approval of a Section 309 Assessment & Strategy, the state program is eligible for Section 309 funds to implement the program improvements outlined in their plan. Similarly, hazard mitigation planning is encouraged by federal legislation, the Disaster Mitigation Act (2000). This act requires state and local governments to have approved mitigation plans in order to be eligible for Federal Emergency Management Agency (FEMA) disaster assistance. Specifically, an approved hazard

mitigation plan is needed to access Public Assistance (post-disaster), Hazard Mitigation Grant Program (post-disaster), Building Resilient Infrastructure and Communities Program (pre-disaster), and Flood Mitigation Assistance (pre-disaster) funding (FEMA, 2022a). Each of these planning programs provide states with planning guidelines, with the minimum information that should be in each plans. NOAA provides planning guidance for each planning cycle (every 5 years), whereas FEMA releases hazard mitigation planning guidance periodically. The associated guidance for the sample of plans evaluated in this study was from 2015. FEMA released new guidance in 2022 which took effect in April of 2023; however, all the hazard mitigation plans assessed were adopted prior to its release. Additional details of each program are shown in Table 7. Assessing these two plans provides insight into how federal programs influence state/territory planning and how federal planning guidelines and funding can be maximized for coastal adaptation.

Table 6 – Plans Assessed per Jurisdiction (n = 12)

Jurisdiction	Name of Plan	Year
U.S. Virgin Islands	*Territorial Hazard Mitigation Plan*	2019
	USVI CZM 309 Enhancement Assessment & Strategy	2022
Puerto Rico	*2021 Puerto Rico State Hazard Mitigation Plan*	2021
	Puerto Rico Section 309 Assessment and Strategy 2023-2025	2022
American Samoa	*Hazard Mitigation Plan May 2020, Territory of American Samoa*	2020
	Section 309 Assessment and Strategy FY 2021-2025	2020
Hawaii	*2018 State Hazard Mitigation Plan*	2018
	Section 309 Assessment and Strategy	2021
Commonwealth of the Northern Mariana Islands	*CNMI Standard State Mitigation Plan 2018*	2018
	Section 309 Assessment and Strategy, 2021-2025	2020
Guam	*2019 Guam Hazard Mitigation Plan*	2019
	2021-2025 Section 309 Assessment and Strategy Report	2020

Table 7 - Crosswalk of CZMA 309 Assessment & Strategy and Hazard Mitigation Plan

	CZMA Section 309 Assessment & Strategy	State/Territory Hazard Mitigation Plan
Authorizing Legislation	Coastal Zone Management Act, Section 309 Coastal Zone Enhancement Program	Disaster Mitigation Act 2000
Federal Lead	NOAA Office for Coastal Management	FEMA – Risk Management Directorate
State/Territory Lead	State Coastal Management Program	State/Territory Emergency Management Agency/SHMO
Planning Cycle	5 years	5 years
Funding Eligibility	Federally approved plan provides access to CZMA Section 309 Funding for coastal program enhancements	Federally approved plan provides access to FEMA pre- and post-disaster assistance: Public Assistance, HMGP, BRIC, FMA
Required Plan Components	• Summary of Achievements • Assessment of Enhancement Areas (incl. Coastal Hazards) • Enhancement Strategy • Stakeholder/Public Engagement	• Capability Assessment • Risk Assessment • Mitigation Strategy – Goals & Actions • Planning Process/Participation

3. Coding and Analysis

Content analysis and coding procedures common to other plan quality work (Berke et al., 2012, 2014; Fu et al., 2017a; Horney et al., 2017b; Lyles et al., 2014; Preston et al., 2011; Tang et al., 2008, 2010, 2013; Woodruff & Stults, 2016) were used to systematically assess plans and determine a score for each of the coastal adaptation principles. Plans were reviewed by a single coder and scored on a scale from 0 to 2, with '0' representing the indicator was not present in the plan, '1' being the indicator was mentioned or listed but without detail, and '2' being the indicator was described in detail or mentioned throughout the plan. The coding protocol is included in Appendix A.

Following similar plan quality studies, scores for each principle were calculated for each plan by summing the scores of all indicators in each principle, dividing by the total possible score for that principle, and multiplying by 10 to place the score on a 0-10 scale. This is shown in Equation 1, where PS_j is the principle score for the jth principle, *i* is the indicator score, and *n* is the number of indicators in the principle. Total plan quality score for each plan was calculated by simply summing the scores for each of the six principles for that plan, as shown in Equation 2, where *TPS* is the total plan score.

$$PSj = \frac{\sum_{i=1}^{i=n}(i_1, i_2, \ldots i_n)}{2n} * 10 \quad \textit{(Max Possible = 10)} \qquad \textit{(Eq. 1)}$$

$$TPS = \sum_{j=1}^{j=6} PSj \qquad \textit{(Max Possible = 60)} \qquad \textit{(Eq. 2)}$$

Descriptive statistics were generated for plan quality scores across all six principles and types of plans (CZMA 309 and Hazard Mitigation), including Mean, Minimum/Maximum, and Standard Deviation of

each principle, and percent plan coverage of each indicator to allow for comparisons across jurisdictions, types of plans, and principles. All scores for each indicator, principle, and plan, along with the percentage of plans that included each indicator is provided in Appendix B. Statistical tests were used to determine if there were significant differences in plan quality scores between types of plans, between informative and responsive principles, and among jurisdictions. Two sample t-tests were used to compare types of plans and to compare informative and responsive principles.

D. Results

1. Overall Plan Quality Scores

The calculated plan quality scores were low to moderate across the six principles, as shown in Table 8. The highest scoring principles were *Integrated Planning* and *Adaptation Intelligence* with mean scores of 6.25 and 6.05, respectively, which is just above the midpoint of the possible total score (10). The lowest scoring principles were *Vulnerability Reduction* and *Nature-Based Adaptation* with scores of 3.17 and 3.47, respectively. Principle scores ranged widely (comparing minimum to maximum) across all plans for most principles, highlighting varied approaches and priorities for adaptation-relevant planning across the sample plans. The highest score a plan received for a principle was 7.86 for Adaptation Intelligence, while the lowest score was 1.25 for Nature-Based Adaptation, highlighting that plans may score high in one principle but also score low on another, compromising the total plan quality (Berke et al., 2012; Horney et al., 2017b; Lyles et al., 2014).

Table 8 – Overall Plan Quality Scores by Principle

Principle	Mean	Minimum	Maximum	Std. Deviation
Adaptation Intelligence	**6.05**	2.38	7.86	1.63
Inclusive Planning	**4.32**	2.73	5.91	0.96
Integrated Planning	**6.25**	4.44	7.78	1.19
Vulnerability Reduction	**3.17**	2.12	5.45	1.05
Nature-based Adaptation	**3.47**	1.25	5.42	1.60
Adaptive Planning	**4.63**	3.61	6.67	0.85

This is demonstrated by the total plan scores (Figure 4) and principle scores (Table 9) across jurisdictions. Total plan scores were also generally low to mid-range across the jurisdictions, with scores ranging from 23.21 (American Samoa CZMA 309) to 35.63 (Hawaii HMP) out of a total possible score of 60. As observed by Figure 4, there was no significant variation in total plan scores across jurisdictions ($p=0.59$). This may be due to islands having similar priorities or capacities or experiencing similar challenges (discussed later). However, examining principle scores for individual jurisdictions in Table 9,

shows considerable ranges in principle scores within plans themselves. For example, most hazard mitigation plans scored above the midpoint in *Adaptation Intelligence* and *Integrated Planning*, but below the midpoint in *Inclusive Planning*, *Vulnerability Reduction* and *Nature-Based Adaptation*. Having a plan that has a robust dataset and engages well across sectors does not necessarily result in a high-quality plan if certain strategies aren't leveraged or don't reflect the values and preferences of the community. This disconnect between information and response is highlighted in the next section.

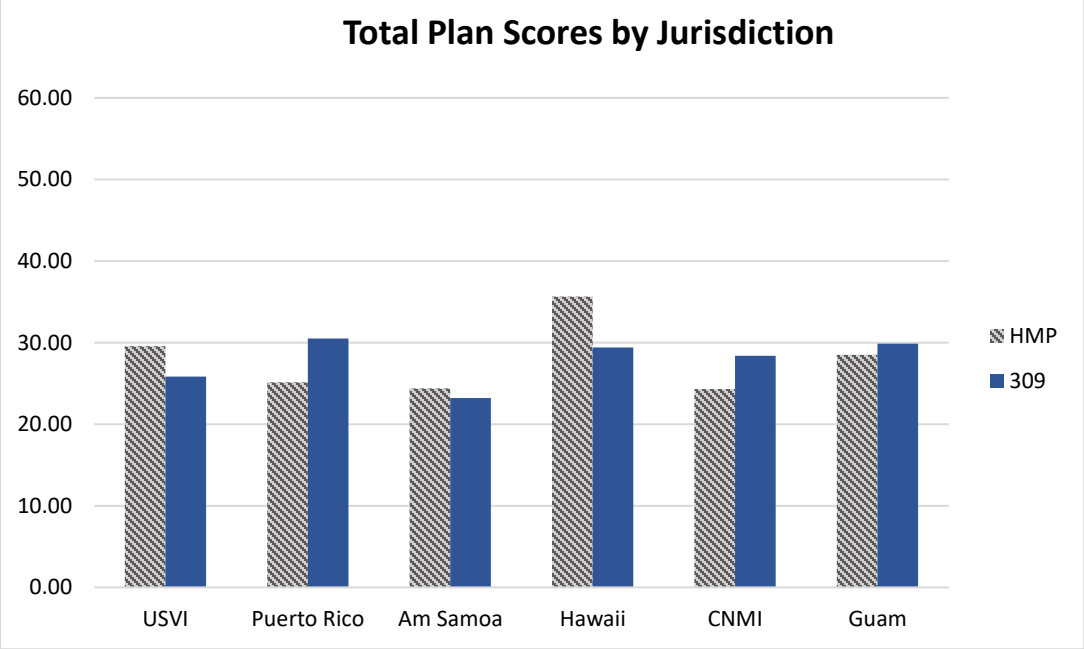

Figure 4. Total plan scores by type of plan and jurisdiction.

Table 9 – Mean Principle Scores and Score Range for Each Jurisdiction

	USVI	*Puerto Rico*	*Am Samoa*	*Hawaii*	*CNMI*	*Guam*	*RANGE*
Hazard Mitigation Plan							
Adaptation Intel	5.48	2.38	7.14	7.86	7.38	5.71	**5.48**
Inclusive Planning	4.00	5.45	2.73	4.55	3.00	4.50	**2.73**
Integrated Planning	7.22	7.78	7.22	7.78	5.56	6.67	**2.22**
Vulnerability Reduction	4.39	2.42	2.42	5.45	2.12	4.55	**3.33**
Nature-Based Adaptation	3.75	2.08	1.25	3.33	1.25	2.08	**2.50**
Adaptive Planning	4.72	5.00	3.61	6.67	5.00	5.00	**3.06**
CZMA 309							
Adaptation Intel	5.71	6.67	3.57	7.14	6.43	7.14	**3.57**
Inclusive Planning	4.50	5.00	3.18	5.91	4.50	4.55	**2.73**
Integrated Planning	6.67	6.11	4.44	5.00	4.44	6.11	**2.22**
Vulnerability Reduction	2.58	2.88	2.42	2.88	2.73	3.18	**0.76**
Nature-Based Adaptation	2.50	5.42	5.42	4.58	5.00	5.00	**2.92**
Adaptive Planning	3.89	4.44	4.17	3.89	5.28	3.89	**1.39**

2. Informative vs. Responsive Principles

The data shows a general disconnect between information and action, with informative principles averaging higher (*Mean=5.5)* than responsive principles (*Mean=3.8*) as seen in Figure 5. While a two-sample T-test did not show a significant difference between informative and responsive principles (*p=0.07*), a general trend can be seen within principles that have both information-related and action-based indicators.

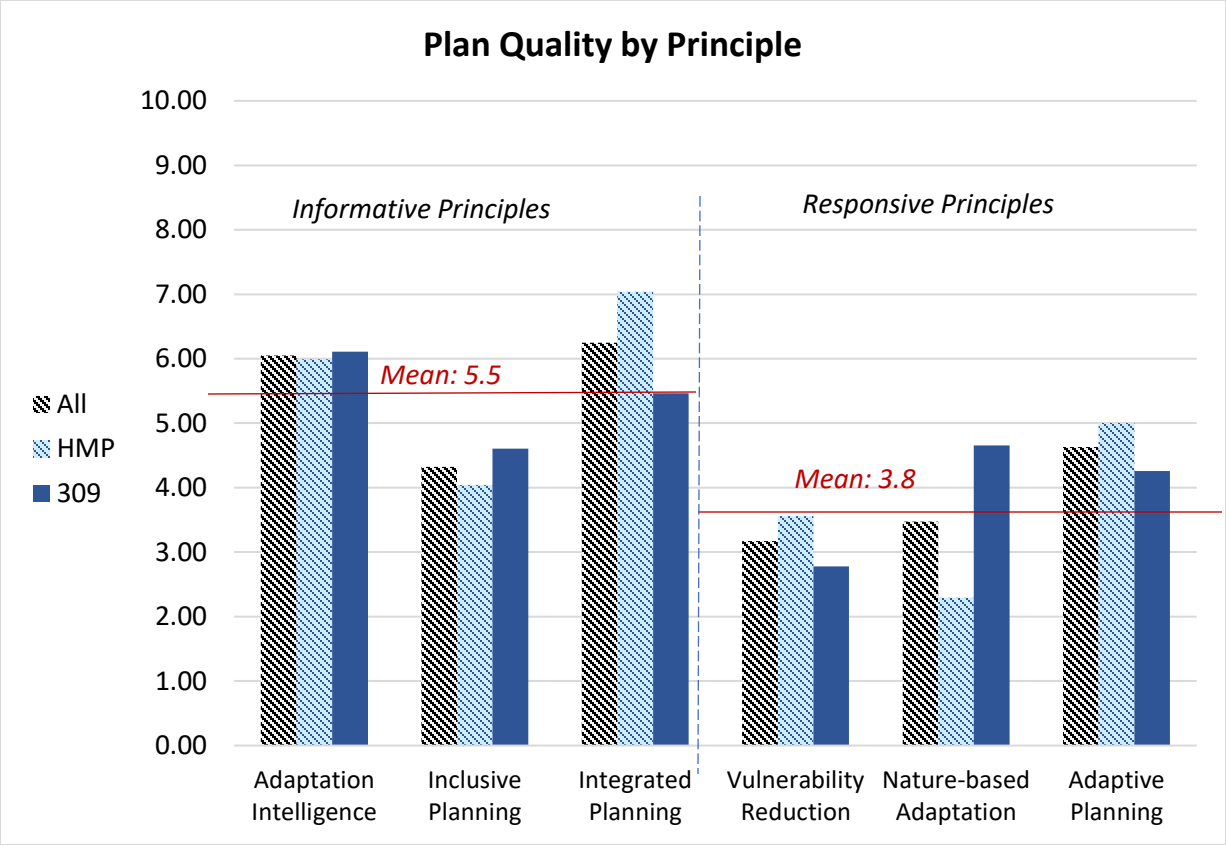

Figure 5. Mean principle scores categorized by *informative* and *responsive* principles.

For example, looking at the *Vulnerability Reduction* category scores in Figure 6, plans tend to score better with the planning/capacity-building strategies, many of which are intended to gather information (through new plans or studies) or disseminate information (through community education), than strategies that change land uses or structures. Figure 7 shows a similar trend within the *Nature-Based Adaptation* principle, where plans tend to include more information related to the natural environment than actual strategies to protect or leverage them for adaptation. The *Adaptive Planning* scores in Figure 8 show a similar pattern, with the scores decreasing as you move from indicators that focus on objectives and processes (Goals, Implementation) versus those that focus on evaluating progress and addressing uncertainty.

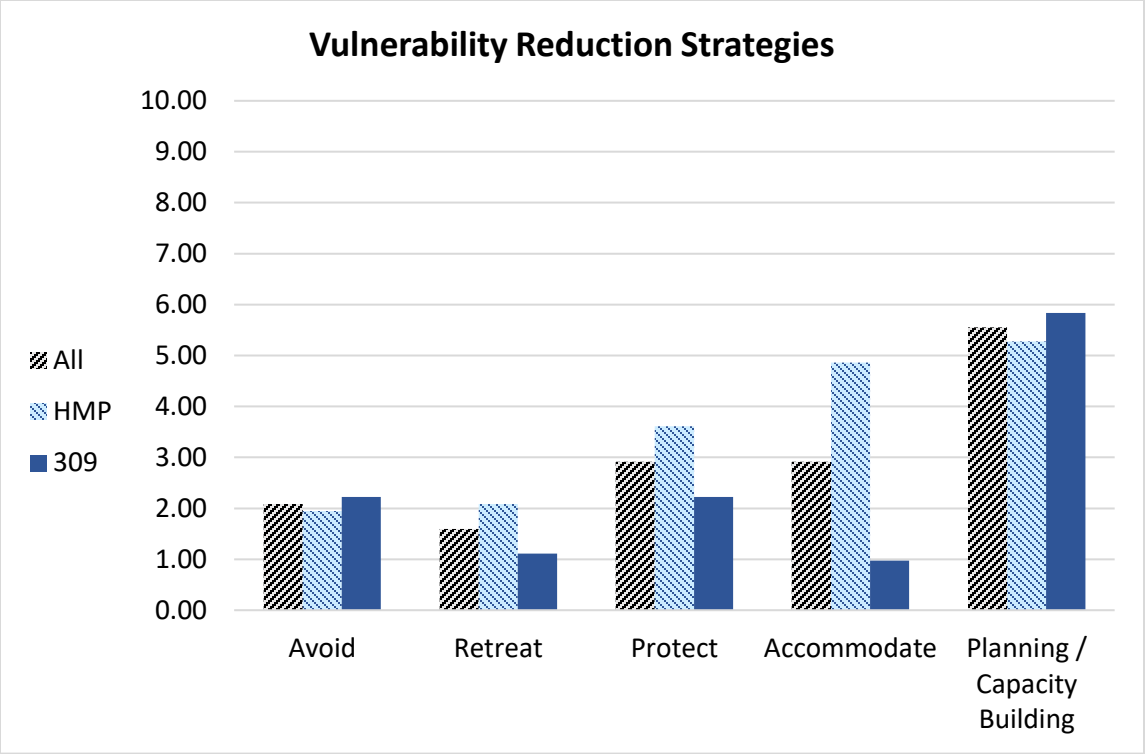

Figure 6. Mean scores for the Vulnerability Reduction Principle by category of strategies.

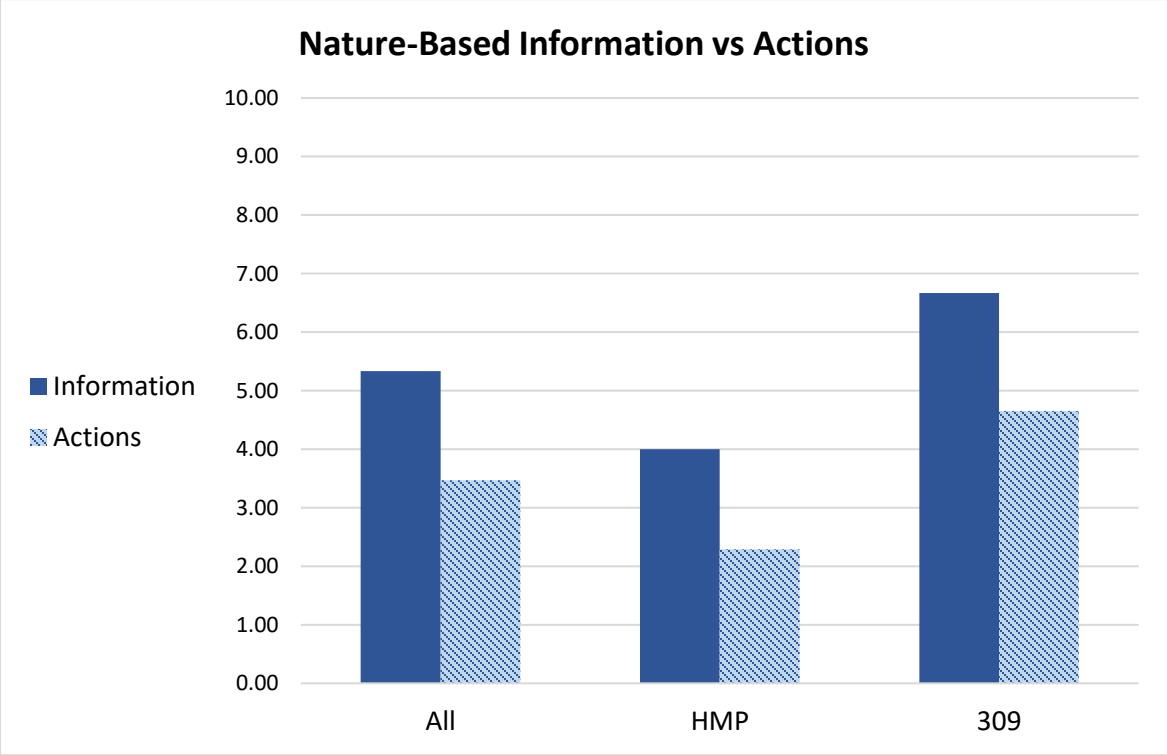

Figure 7. Mean scores for indicators related to nature-based information vs nature-based actions.

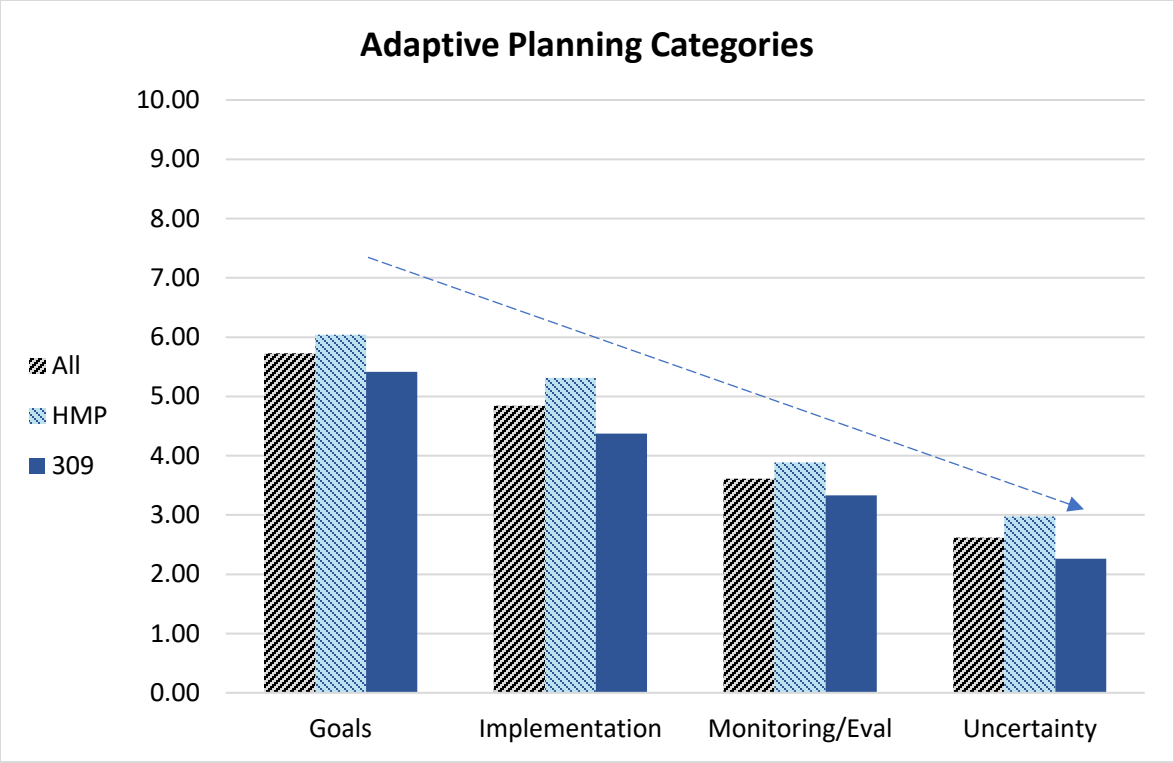

Figure 8. Mean scores for the Adaptive Planning Principle by category.

Another result of note is the *Inclusive Planning* principle, which assesses indicators related to the planning process and equity. Figure 9 highlights the mean indicator scores on a 0-2 scale across all plans. Importantly, plans included substantially more information describing the planning process (*Mean=1.92*) and engagement tools than strategies that target vulnerability in underserved communities (*Mean=0.5*). No plans (*Mean=0*) indicated that underserved or vulnerable communities were involved in the planning process, and few included meaningful roles for community organizations in the process (*Mean=0.67*). This shows a need for improvement in equity considerations in these types of plans.

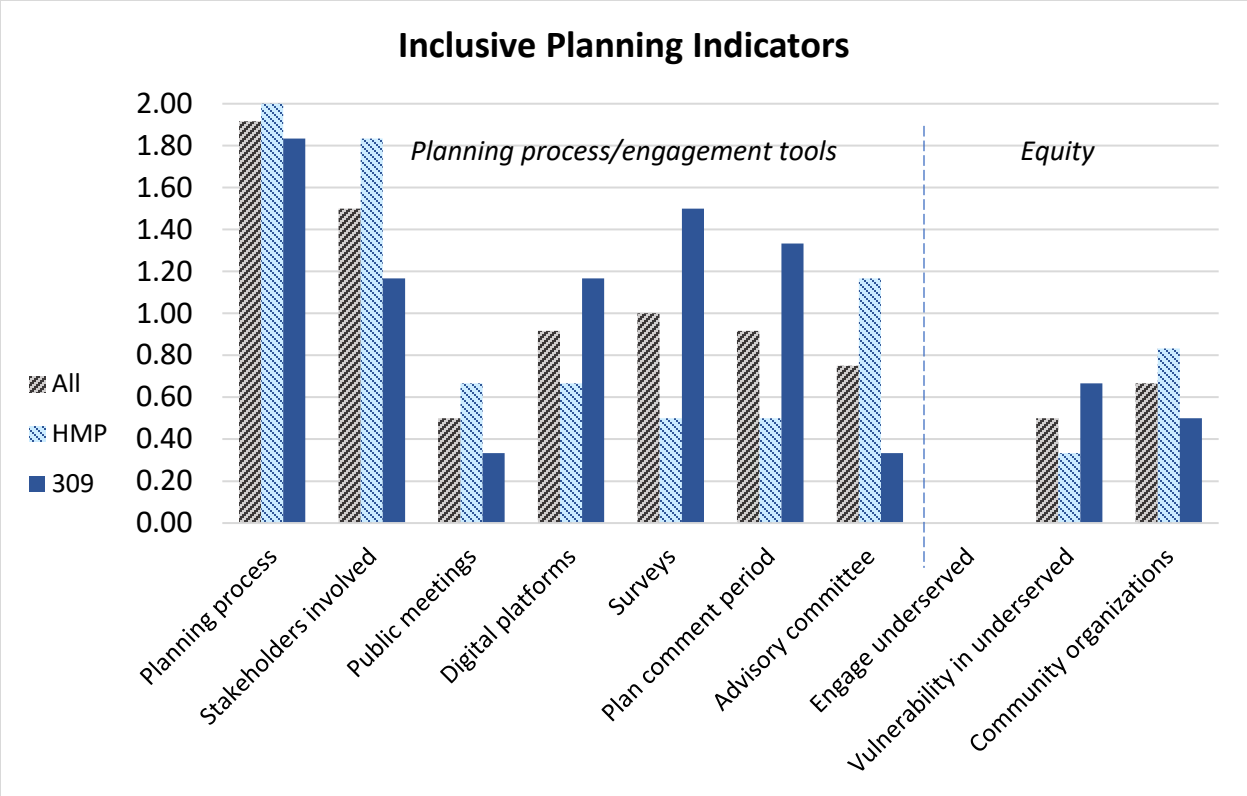

Figure 9. Mean indicator scores (0-2 scale) for the Inclusive Planning principle.

3. CZMA 309 Assessment & Strategy vs. Hazard Mitigation Plans

A two-sample t-test was used to assess the difference in principle scores across the types of plans – CZMA 309 Assessment & Strategy and hazard mitigation plans. Table 10 provides descriptive statistics for each principle across types of plans, as well as *p-values* resulting from t-tests. There were significant differences between types of plans for the *Integrated Planning* (*p=0.013*) and *Nature-Based Adaptation* (*p=0.003*) principles. There were no statistically significant differences among other principles, however there were significant differences for certain indicators within these principles, notably within the *Adaptation Intelligence* and *Vulnerability Reduction* principle. For Adaptation Intelligence, CZMA 309 plans better accounted for current wetland and reef conditions than hazard mitigation plans, with 100% of 309 plans including these indicators while only 33% (wetlands) and 67% (reefs) of hazard mitigation plans covered these. Hazard mitigation plans better accounted for the impacts of hazards on vulnerable populations within their risk assessments, with 100% of hazard mitigation plans including this information whereas 33% of 309 plans did. Within *Vulnerability Reduction*, there were differences in the use of shoreline setbacks (*Avoid*); relocation (*Retreat*); flood protection (*Protect*); and elevation, floodplain management, and structural retrofits (*Accommodate*). CZMA 309 plans were more likely to mention the use of shoreline setbacks, whereas hazard mitigation plans were more likely to leverage relocation, flood protection and accommodate strategies.

Table 10 – Hazard Mitigation Plan and CZMA 309 Plan Quality Scores by Principle

Principle	Mean		Minimum		Maximum		Std. Deviation		T-test (*p-value*)
	HMP	**309**	**HMP**	**309**	**HMP**	**309**	**HMP**	**309**	
Adaptation Intelligence	5.99	6.11	2.38	3.57	7.86	7.14	2.01	1.35	(0.906)
Inclusive Planning	4.04	4.61	2.73	3.18	5.45	5.91	1.03	0.88	(0.329)
Integrated Planning	**7.04**	**5.46**	5.56	4.44	7.78	6.67	0.84	0.96	**(0.013)**
Vulnerability Reduction	3.56	2.78	2.12	2.42	5.45	3.18	1.41	0.27	(0.210)
Nature-based Adaptation	**2.29**	**4.65**	1.25	2.50	3.75	5.42	1.05	1.10	**(0.003)**
Adaptive Planning	5.00	4.26	3.61	3.89	6.67	5.28	0.98	0.55	(0.136)

E. Discussion - Room to Improve Plan Quality across Islands

Results show that there is room to improve plan quality among the sample plans. This result is common across similar plan evaluations of coastal land use (Fu et al., 2017b; Tang et al., 2008), hazard mitigation (Fu et al., 2017b; Horney et al., 2017b; Lyles et al., 2014; Lyles et al., 2014), recovery (Berke et al., 2014), resilience (Woodruff et al., 2018) and adaptation plans (Baker et al., 2012; Woodruff & Stults, 2016). Although each study used slightly different principles and indicators, so not directly comparable, there has been a general trend in low quality plans relevant to hazards and climate change, especially in coastal areas. This study confirms that this type of planning in island settings also has room for improvement, with specific challenges and takeaways for islands.

1. Limited use of land use approaches for adaptation

Consistent with other studies (Berke et al., 2012; Berke et al., 2014; Horney et al., 2017b; Lyles et al., 2014; Lyles et al., 2014), the island plans scored low in the categories related to reducing risk through land use strategies. The *Avoid* (2.08) and *Retreat* (1.6) categories in the *Vulnerability Reduction* principle scored less than the *Protect* (2.92) and *Accommodate* (2.92) categories and much less than the *Planning/Capacity Building* (5.56) category. This preference towards capacity-building, protecting and accommodating over relocating or preventing development has been reported by others (Butler et al., 2016; Fu et al., 2017a) and could be attributed to several things – general adaptation progress, the limited availability of land on islands, the uncertainty of impacts and effectiveness of options. Adaptation planning in general is in preliminary stages having only recently gathered momentum (Bierbaum et al., 2013). This leads current adaptation efforts towards gathering more information than to concrete actions as noted by Baker et al. (2012), especially new types of actions. Structural solutions have long-been used in hazard risk reduction efforts, while land use solutions and relocation are much less common (Berke et al., 2012). This is partly due to federal policies that have incentivized development (and protection of that development) in hazardous areas (Burby et al., 1999), connections to one's private property, and the relative simplicity of structural solutions over land use solutions (Berke et al., 2012). This is especially

challenging in island jurisdictions, where land is limited and therefore connections to and reliance on existing structures are strong and the opportunity costs of preventing development may be greater. Managing development is a commonly noted challenge among the sample plans, with the ineffectiveness or lack of enforcement of coastal regulations resulting in development in hazardous areas. This development commonly occurs without permits or with easily obtained waivers. Some plans (Guam 309, CNMI 309, Hawaii 309, Puerto Rico 309, USVI 309, Am Samoa HMP, Puerto Rico HMP) explicitly note regulatory and land use improvements in their identified goals and priorities. However, the staff capacity to enforce and implement regulatory changes was a noted challenge among most plans. The uncertainty of climate impacts and lack of local scale climate information may also play a role in choosing effective adaptation options (Baker et al., 2012; Butler et al., 2016), with many existing adaptation plans leaning towards lower-risk capacity-building actions (Butler et al., 2016; Preston et al., 2011). This may explain the preference of plans in the study sample for planning and capacity-building strategies, and informative principles in general. The gaps in available data for the island jurisdictions was noted in several plans, as publicly available climate related datasets are not as robust as in the continental U.S. Addressing these data gaps would help planners better identify concrete actions to address risk and lessen the need for more plans and studies.

2. Need to address uncertainty.

The need to better address uncertainty is highlighted in the results, with these uncertainty-related indicators (*adaptation pathways [0]*, *scenario planning [0.42]*, *no-/low-regrets strategies [0]*) being among the lowest scoring. Scenario planning was noted in plans, but only to the extent that different sea level rise scenarios were considered in assessing vulnerability, but no plans identified strategies across multiple scenarios. The lack of strategies to address uncertainty has been found in other studies that have included uncertainty in their plan evaluation (Woodruff, 2016; Woodruff et al., 2018; Woodruff & Stults, 2016). Woodruff & Stults (2016) suggest that this may be due to the capacity and cost to implement these types of approaches. Planning staff capacity is low across the island jurisdictions, as noted in most plans, which may translate to the limited use of these types of approaches. Low regrets strategies and scenario planning can be effective ways to address uncertainty (Butler et al., 2016; Woodruff, 2016; Woodruff & Stults, 2016), therefore encouraging these approaches in planning requirements and providing guidance on how to do so would help improve island planning in this area. Other recommendations to better address uncertainty include ensuring monitoring and evaluation takes place and improving the communication and credibility of climate information, especially in the eyes of decision-makers (Butler et al., 2016; Woodruff, 2016).

3. Emergent Priorities – Nature-Based Solutions and Equity

Two areas that did not score well among the sample plans were *Nature-Based Adaptation* and the equity aspects of *Inclusive Planning*. However, it is important to note the date of these plans (ranging from 2018 to 2021) relative to new federal policies and priorities related to nature-based solutions and

equity. Federal interest and attention in climate change, nature-based approaches, and equity have increased in recent years, especially within FEMA. The 2022-2026 FEMA Strategic Plan emphasizes both climate adaptation and equity within the goals (FEMA, 2022), while FEMA also has recently released guidance encouraging the use of nature-based solutions (FEMA, 2021; 2023). NOAA has also been stressing nature-based solutions and equity through the recent cycles of competitive grant programs, such as the National Coastal Resilience Grant which is co-managed with the National Fish and Wildlife Foundation. Recent federal legislation, such as the Inflation Reduction Act and the Bipartisan Infrastructure Law have provided substantial investment in climate resilience, with many of the resulting funding opportunities including nature-based solutions and equity considerations as proposal criteria. The recent focus on these topics will likely lead to more consideration of *Nature-Based Adaptation* and *Inclusive Planning* approaches in the next cycle of CZMA 309 strategies and hazard mitigation plans. The evolution of island plans over time and the influence of these federal initiatives on these two principles could be a subject of further research.

a) Recognition of natural resources, but not nature-based solutions

While these federal initiatives may influence the future cycle of plans, the current sample plans do not score well in the Nature-Based Adaptation principle. As noted in Figure 7, plans include many of the nature-based information indicators in the *Adaptation Intelligence* principle (wetland/reef/beach conditions, vulnerability of ecosystems), with these indicators having a mean score of 5.33. This is notable, especially for hazard mitigation plans since hazard mitigation planning guidance does not necessarily require a detailed accounting of ecosystem conditions or vulnerability. Natural systems and nature-based solutions are even explicitly noted in the listed goals and management priorities of several plans (Am Samoa 309, Puerto Rico 309, CNMI HMP, Puerto Rico HMP, USVI HMP). This may reflect the importance that island communities place on their natural resources, such as reefs, beaches, and wetlands; since they often have significant social, cultural and economic value in island settings. However, the value placed on these natural systems has not translated to *Nature-Based Adaptation* strategies, with this principle scoring just 3.47. This could be due to nature-based solutions having grown in interest since these plans were developed, the developing understanding of the design and use of nature-based solutions, the current planning capacity to develop these solutions, or the historic preference towards structural solutions for hazard mitigation. Other studies have also found sub-optimal use of ecosystem-based approaches in land use plans (Brody, 2003; Woodruff & BenDor, 2016). Although, limited in their use to date, nature-based solutions are a critical part of the adaptation toolkit and have potential to reduce risk and provide other societal and economic benefits (Moser et al., 2012; Spalding et al., 2014; Tobey et al., 2010). Incorporating considerations of ecosystems and the services they provide in the development and evaluation of plans can help foster their use as planning solutions (Woodruff & BenDor, 2016).

b) Equity Considerations – Process and Outcomes

As noted in Figure 9, current plans do not score well in the equity-related indicators of the *Inclusive Planning* principle. Consideration of equity is an important part of adaptation planning (Hurlimann et al., 2014), especially in a coastal setting (Cooper & McKenna, 2008; Stallworthy, 2006). The intent of this principle is to ensure adaptation planning meets both the procedural and distributive aspects of justice - that it strives for equity in both the processes and outcomes. It is important to note that none of the plans in the sample explicitly included underserved communities in the planning process. Most plans included public participation techniques, such as surveys and public comment periods, but these techniques don't always reach those members of the community that are most impacted by disasters and may not have the resources to participate in the planning process. Few plans listed community-based organizations (that may represent these groups). Dedicated purposeful strategies to engage these groups may be needed to gather their input and understand how policies affect the most vulnerable. Hazard policies, such as buyouts, have been shown to leave out these groups in planning processes, even when those groups are most impacted by those policies possibly creating distrust (Mach et al., 2019; Siders, 2019b). Participation of groups that are most impacted by hazards and planning outcomes helps to repair that trust while also improving understanding of vulnerability and crafting more effective solutions. Some of the sample plans included examples of strategies that are a step in this direction. Most of these efforts relate to mapping social vulnerability indexes to identify vulnerable populations and inform decision-making (Guam 309, CNMI 309, USVI 309). Puerto Rico's proposed Coastal Resilience Program outlined in their CZMA 309 Strategy takes it one step further, including social vulnerability as a criterion for prioritizing projects. These types of approaches that target risk in underserved communities would maximize risk reduction efforts, as these communities are often the most impacted by disaster. This is important in islands where resources and capacity are limited, household income levels are typically below those in the continental U.S., and the topography can cut off vulnerable communities from transportation networks and supply routes.

4. Potential leverage points for island planning

a) Leveraging networks for cross-sector collaboration and participation

Although there is room for improving plan quality across the sample plans, there are some important strengths and opportunities of island planning that may be leveraged that may help improve future updates of these plans and ultimately adaptation. One strength that stands out among principle scores is that of *Integrated Planning*, with the highest mean score among principles (6.25). This principle included indicators assessing the reference to other plans (land use, coastal management, hazard mitigation) and involvement of those associated planners in the process. Although there is room for improvement, this score is generally higher than that of similar evaluations of hazard-related plans in the continental U.S where coordination between government sectors and plans was a criterion (Fu et al., 2017b; Horney et al., 2017b; Lyles et al., 2014; Woodruff & Stults, 2016). The stronger integration scores for island plans may be a result of their smaller geographic scale and smaller size governments allowing for easier cross-

sectoral collaboration. Islands often benefit from tighter social networks and stronger social capital which may play a role in this collaboration. These networks can be leveraged to improve *Integrated Planning* even further, as well as for improving *Inclusive Planning* by providing for more meaningful participation from the public, including the most disadvantaged communities.

b) Leveraging nature for coastal adaptation

The recognition and appreciation for natural resources is important, as it can simplify advocacy for nature-based solutions since the enjoyment or use of natural resources for sustenance are often a part of daily life. This means getting cross-sectoral and public support for nature-based approaches may be easier, helping to improve *Nature-Based Adaptation* in future iterations of plans. This will be important for islands that are experiencing rapid ecosystem degradation due to development pressure. Federal grant requirements to consider nature-based solutions will help with this. There are still challenges related to the still-developing practice of nature-based solutions, with expertise and best design practices needing development, especially in island jurisdictions lacking planning capacity.

c) Leveraging disasters as adaptation opportunities

The last leverage point is certainly not a strength, but perhaps an opportunity to advance adaptation in the future. Each of the island jurisdictions has the unfortunate exposure to a multitude of hazards and the regrettable experience of having significant disaster declarations in recent years. These experiences are noted in several of the plans. It is likely with climate change that islands will once again feel the brunt of large-scale disasters in the future. These events, as difficult and taxing as they are, can serve as opportunities to implement policy or development changes to create more resilient communities in impacted areas. The influx of funding that accompanies federal disaster declarations can help advance resilience through the recovery period, ensuring communities are built back to higher design standards or out of harm's way, or that natural systems are restored and protected (Berke et al., 1993; Smith & Wenger, 2007). The pressure to recover quickly after a disaster may inhibit taking advantage of this opportunity (Olshansky et al., 2012), therefore pre-disaster recovery planning is important to help identify potential *Vulnerability Reduction* opportunities and address tradeoffs without the chaos and pressures of the post-disaster environment. Recovery planning can also provide an opportunity to address existing inequities and improve *Inclusive Planning* practices (Berke et al., 1993; Kim et al., 2021; Olshansky et al., 2012). As some of the island jurisdictions are currently struggling with recovery from recent disasters, the "window of opportunity" that disasters provide to implement change (Platt & So, 2017) may be rapidly closing. Integrating adaptation into this process is likely easier said than done amid the complexities of post-disaster funding and political and social pressures to get back to normal. There may be lessons to be learned from current recovery experiences that can be integrated into future planning efforts – whether coastal management, hazard mitigation, or even new pre-disaster recovery plans – to help leverage future windows of opportunity.

F. Conclusion

Evaluation is a key component of adaptation, considering the uncertainty of future climate impacts and effectiveness of options. Adaptation planning should therefore be an iterative process and learning endeavor, taking lessons from current experiences to help improve future outcomes. Plan evaluation can be part of that learning process and play a key role in future planning by identifying the strengths and weaknesses of current efforts and opportunities for improvement (Berke & Godschalk, 2009). Previous plan evaluation work has highlighted components of plan quality and evaluated the quality of plans across multiple lenses. This study builds on these efforts and contributes a tailored framework for evaluating plans that are vital to coastal adaptation and examines a study area that has yet to be explored --- planning across island jurisdictions. Findings highlight the need to establish better connections between information and responses, the need to better consider and address uncertainty through flexible approaches, the need to protect and leverage natural systems for adaptation, and to improve the consideration of equity in planning processes and outcomes. There are also potential opportunities to leverage the unique experiences of islands, including the value placed on nature, the strong social bonds and networks, and federal funding associated with disasters. It is hoped that these findings are helpful for future planning in the islands, as well as the consideration of existing planning mechanisms as vehicles for adaptation planning. The concluding thoughts below highlight limitations of the research which present potential questions for future research.

1. Research Limitations

a) Methodological Limitations

There are limitations to the research that are important to consider when interpreting findings, but that also present opportunities for future research. The first limitation is methodological. Many plan evaluation studies use multiple coders to score plans, calculating intercoder reliability as a means to report data reliability (Berke & Godschalk, 2009; Lyles & Stevens, 2014). This is considered a best practice in this type of analysis, although many studies do not fully utilize this approach (Lyles & Stevens, 2014). This study uses a single coder to review and score plans, an apparent limitation. Although multiple coders and intercoder agreement is recommended, some argue that coding can be a subjective process and multiple coders may introduce inconsistencies and in fact reduce reliability (Norton, 2008). For the purpose of this study, the single coder (author) developed the protocol and had subject matter expertise in the research topic, ensuring consistency across measurements. Future work may consider using multiple trained coders to score the same principles, indicators, and plans to confirm data reliability.

b) Contextual Limitations

Other limitations are more contextual and may apply to other plan evaluation studies in other locations. The first limitation is the timing of plans, as the sample plans were adopted at different times. The timing of plans and relevant federal policies at the time of adoption may influence the content of plans, as mentioned above, and must be considered when interpreting results. Future work may consider

examining future iterations of plans to assess how plans evolve over time. The other limitation is the types of plans. The planning landscape in the study area determines the types of plans that can be evaluated and compared. There may be other plans among the island jurisdictions that are relevant to adaptation, such as transportation plans or watershed management plans, which were not considered since they weren't common across all of them. One plan that is common across the jurisdictions that wasn't considered is the Comprehensive Economic Development Strategy required for eligibility for US Economic Development Agency funding. This plan was not included in the study, since it is not specific to coastal hazards or issues but may include elements that are relevant to adaptation. Future work may benefit from including this and other common plans, especially those tied to federal funding, in the evaluation.

Lastly, this evaluation treats plans themselves as the object of research, inferring the state and quality of planning in that locale based on the content of the plan alone. Although useful in determining what a plan covers well and what is missing, the inferences regarding process and context (and even strategies) can only be made based on what the plan contains regarding these aspects. Therefore, scores may not necessarily reflect how 'good' or 'bad' a plan is, but only if and how well they address the specific indicators used for the plan evaluation. Whether or not plans do address them may be due to external factors, such as data availability, priorities of the jurisdiction, planning capacity, or the requirements of the federal guidance related to these plans. Alternatively, there may be strategies utilized in the study area that are not mentioned in these plans but are in others, or there may be procedural nuances, contextual constraints, or baseline conditions that are not mentioned in the plan but influence the results and differences across the jurisdictions. This is where the utility of multiple methods to assess not only plans, but planning is underscored. The following study complements the plan evaluation and employs a qualitative approach to uncover some of the nuances that may not be expressed in the plans themselves.

CHAPTER 4. A QUALITATIVE ANALYSIS OF ADAPTATION PRIORITIES, CHALLENGES, AND INNOVATIONS ACROSS U.S. ISLAND JURISDICTIONS

A. Background

The vulnerability of islands to climate change and associated hazards has been widely acknowledged in global (Mycoo et al., 2022) and U.S. climate assessments (Díaz et al., 2018; Keener et al., 2018). Often times, islands are the smallest contributors to climate change but experience some of its worst effects (Betzold, 2015; Lazrus, 2012), making island adaptation a crucial yet complex process. Much of the attention regarding islands and climate change has been focused on Small Island Developing States (SIDS), lists of which include U.S. island territories (Robinson, 2020). Synthesis research on SIDS has aimed to measure and identify climate adaptation progress, strategies, successes and barriers to adaptation in these settings (Betzold, 2015; Klöck & Nunn, 2019; Kuruppu & Willie, 2015; Robinson, 2020). There are examples of adaptation efforts on islands (Mcleod et al., 2019) and the body of research on island adaptation has grown in recent years (Robinson, 2020); however, like elsewhere, adaptation is progressing slowly (Betzold, 2015) and research needs still exist (Kelman & Khan, 2013; Robinson, 2020). Among the barriers to adaptation on islands, those related to 'perception and awareness', 'institutions', and a 'lack of resources' have been highlighted (Betzold, 2015). The uncertainty of climate impacts and available information also hinders the ability of decision makers to commit to adaptation actions (Barnett, 2001). Kuruppu and Willie (2015) classifies adaptation challenges in SIDS across 'financial', 'technical', 'cognitive', 'cultural', 'governance', and 'other' barriers; similar to the types of adaptation barriers identified in other settings (Biesbroek et al., 2013; Eisenack et al., 2014; Moser & Ekstrom, 2010).

As noted in Chapter 2, adaptation can and is often facilitated by integrating adaptation into other planning realms. Coastal management (Falaleeva et al., 2011; Moser et al., 2012; Tobey et al., 2010) and hazard mitigation planning (Berke & Lyles, 2013; Blanco et al., 2009; Lyles et al., 2018; Matos et al., 2022) have inherent links to adaptation in coastal and island settings. Many climate change-related hazards, such as sea level rise and tropical cyclones, directly threaten coastal and island communities, exacerbating the development and resource challenges faced by coastal managers (Moser et al., 2012; Tribbia & Moser, 2008). However, the adaptive management and ecosystem-based approaches to coastal management can be integral tools for adaptation planning (Tobey et al., 2010). Hazard mitigation planning also offers valuable lessons and approaches to plan for adaptation, including risk-reduction strategies (Lyles et al., 2018) and lessons learned from the constraints of hazard mitigation planning (Berke & Lyles, 2013). Some have highlighted the need for stronger connections between adaptation efforts and coastal management and hazard mitigation plans (Matos et al., 2022; Tang et al., 2013). Since these two plans are common across the U.S. Island jurisdictions, as highlighted in Chapter 3, evaluating the processes and barriers associated with these planning mechanisms can help identify

opportunities to strengthen their connection to advance adaptation in the islands. Similar to other research identifying barriers, this study employs a qualitative approach to do so.

B. Literature Review – Qualitative Adaptation Planning Evaluations in Coastal and Island Communities

Chapter 2 describes some of the ways in which researchers have evaluated coastal management, planning and adaptation through various lenses – be it from a policy, governance, or plan quality lens, or the interactions among them. Chapter 3 dives deeper into the plan quality literature, highlighting how quantitative plan evaluation methods have been applied to adaptation, coastal management and hazard mitigation. This section provides a review of research that has taken a qualitative approach to evaluating these fields in coastal and island settings, either as a stand-alone method or to provide depth to quantitative studies.

1. Planning Research

Qualitative methods, such as case studies and interview-based research, help to uncover the process nuances not captured within planning documents and can help identify barriers to adaptation in particular settings. Several have explored the processes and planning systems in which adaptation occurs at the local level, with specific implications for urban and land use planning (Hurlimann et al., 2014; Macintosh, 2013; Measham et al., 2011). Hurlimann et al. (2014) use multiple methods (interviews, policy analysis, observation, document review) to examine how the planning institutions (policies, agencies, governance) influenced adaptation planning actions in a coastal community in Australia. They find that planning mechanisms regulating development influence adaptation but focus primarily on future development and do not adequately address existing development at risk or meet criteria for sustainable adaptation. Macintosh (2013) assesses coastal climate hazard planning in Victoria, Australia through document review and semi-structured interviews. Macintosh (2013) highlights maladaptive planning responses, such as deterministic decision-making resulting in inflexible policies ineffective against climate uncertainty, the disregard of opportunity costs and transaction costs of planning actions resulting in inequities and inefficiencies, and inconsistency among responses. Examining three municipalities in Sydney, Australia through in-depth interviews, Measham et al. (2011) identify challenges for local government related to information constraints, institutional constraints, planning processes, leadership, and competing priorities. Measham et al. (2011) highlight that adaptation is not yet manifested in land use planning and emphasize the challenges of local planning operating within higher-level governance frameworks. Gurran et al. (2013) also emphasize the local governance challenges of adaptation through surveys and focus groups, highlighting that local planning is driven by state policies and frameworks, and at least partially dependent on state, federal or third-party funding. Others have employed interviews of practitioners to augment evaluations of adaptation plans in Australia (Baker et al., 2012), Florida (Butler et al., 2016), and in select U.S. cities (Woodruff, 2016). These studies use interview findings to provide context to observations in planning documents, highlighting barriers to adaptation progress (Baker et al.,

2012), reasons for incremental action (Butler et al., 2016), and needs for addressing uncertainty (Woodruff, 2016). Horney et al. (2017) also gather practitioner perspectives through interviews to augment a review of hazard mitigation plans in rural settings, uncovering contextual factors and procedural difficulties that lead to low plan quality in rural communities.

2. Coastal Adaptation Research

Due to coastal management's role in adaptation along the coast, many have explored the emerging connections between coastal management and adaptation, particularly through the coastal practitioners' perspective. Moser and Luers (2008) suggest that responsibility of managing climate risk falls largely on coastal resource managers at the state and local level. They develop a framework to evaluate the capacity of coastal managers in California, characterizing adaptation through three stages – *awareness*, *analytical capacity*, and *action*. Through interviews with coastal managers across the state, they find that awareness and analytical capacity is directly tied to availability of climate information and the way it is conveyed, while the capacity for action is affected by barriers related to "the lack of financial resources, technical constraints, institutional constraints, cultural norms, politics, and social acceptability of options" (Moser & Luers, 2008, p. S316). Tribbia and Moser (2008) expand on the information needs of coastal managers to manage climate risks. Through surveys and interviews of coastal managers, they find that there is a disconnect between scientific information and decision-making processes along the coast and that coastal managers need additional capabilities to optimally leverage climate information for adaptation. This capacity can be augmented by boundary organizations, such as academic and non-governmental organizations (Tribbia & Moser, 2008). Beyond information needs, others have examined the connection between coastal governance systems and the capacity for adaptation (Falaleeva et al., 2011), and specifically for retreat (Abel et al., 2011). Falaleeva et al. (2011) examine the potential to integrate coastal zone management frameworks and adaptation policymaking in a combined governance approach. They draw on the principles of Earth Systems Governance and its criteria – *credibility, stability, inclusiveness,* and *adaptiveness* – to identify barriers of current coastal management and adaptation policies, such as fragmented coastal management authorities, and opportunities for integration, such as leveraging stakeholder participation in coastal management efforts (Falaleeva et al., 2011). Abel et al. (2011) examine governance implications of planned retreat in Southeast Queensland, Australia. They argue that under current governance regimes and development pressures, the potential for retreat will diminish and the pressure to defend will result in its institution as the dominant adaptation strategy. They present 5 principles of governance (changes) to facilitate and increase the potential for retreat, including more equitable distribution of costs/risks, leveraging disaster policy windows, and incentivizing changes in development patterns (Abel et al., 2011).

3. Islands-Specific Research

Qualitative adaptation research has also explored adaptation from the specific perspective of islands, especially SIDS. Beyond the systematic reviews of adaptation progress in SIDS (Klöck & Nunn,

2019; Kuruppu & Willie, 2015; Robinson, 2020), there have been regional investigations of progress and examples of ecosystem-based adaptation across SIDS in the Pacific (Mcleod et al., 2019) and the Caribbean (Mercer et al., 2012). Although barriers such as island remoteness and lack of capacity exist (Mcleod et al., 2019), island ecosystems and the integration of local and external knowledge provide opportunities for adaptation on islands (Mcleod et al., 2019; Mercer et al., 2012). Besides regional reviews, researchers have also employed qualitative approaches to examine adaptation issues on specific islands (Harangody et al., 2022; Johnston, 2014; López-Marrero, 2010; Mortreux & Barnett, 2009). Mortreux and Barnett (2009) analyze semi-structured interviews with residents in Funafuti, Tuvalu to gauge local perceptions of climate change-induced migration, finding that migration is not a widely accepted inevitability among residents, with this sentiment being driven by perceptions of risk and strong connections to the island. Harangody et al. (2022) also highlight connection to place as a factor of community resilience on islands. Interviewing flood survivors and responders in Kauai, Hawaii, Harangody et al. (2022) find that placed-based relationships, knowledge, and capacities helped fill gaps in government response and facilitate recovery from devastating floods in 2018. These community responses were grounded in connections to community, environment, and characteristics of traditional ecological knowledge systems (Harangody et al., 2022). Johnston (2014) emphasizes the need for self-reliance in island communities, especially on small remote islands. Using semi-structured interviews of residents of Druadrua Island, a remote island in Fiji, Johnston (2014) highlights the necessary resilience of remote islands due to imbalances of disaster relief between main and outer islands in Fiji. Lopez-Marrero (2010) explores the determinants of adaptive capacity, interviewing residents of flood-risk communities in Puerto Rico. Adaptive capacity to floods was found to be driven by residents' access to or lack of resources, perception of risk, and reliance on outside aid (López-Marrero, 2010). These studies, grounded in conversation, show the power of qualitative approaches for gaining deep insight from those most directly affected by or involved in adapting to climate impacts on islands.

C. Methods and Data

1. Coastal Adaptation Planning Evaluation Framework

This study employs similar qualitative methods described above, namely the use of semi-structured interviews and qualitative analysis to identify emergent themes in the topic of interest – in this case coastal adaptation planning across U.S. Island jurisdictions. The use of interviews is a common approach in social science disaster research (Peek et al., 2020). The approach for this study is based on the *Coastal Adaptation Planning Evaluation Framework* described in Chapter II.B.2 and employed in the plan evaluation of Chapter III. Whereas the plan evaluation focused primarily on the planning outputs, this study shifts focus to the planning processes and context as shown in Figure 10.

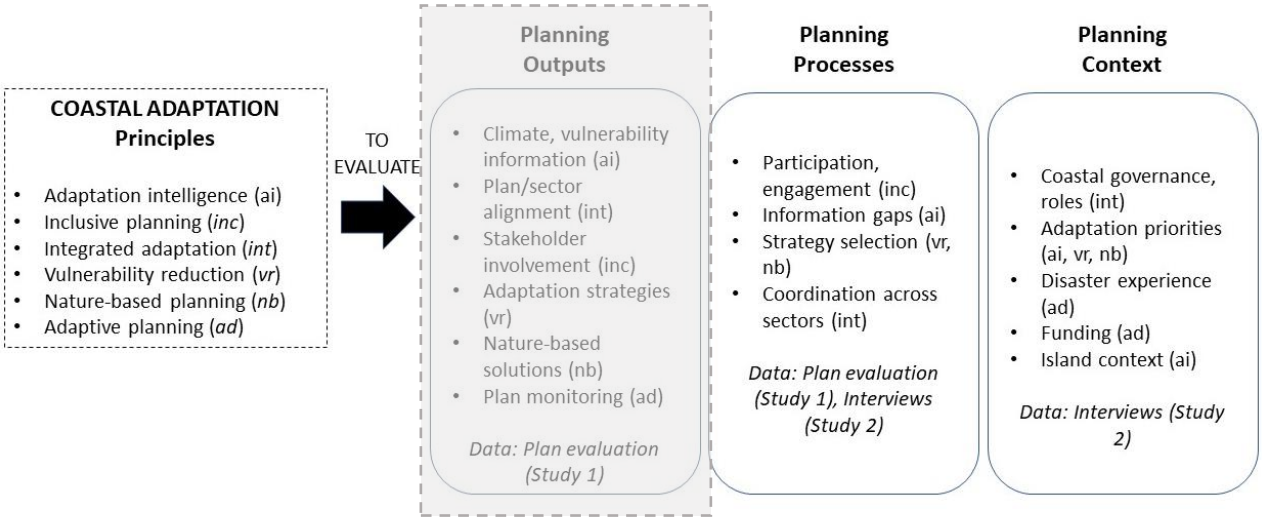

Figure 10. Coastal Adaptation Planning Evaluation Framework, indicating focus of the study.

2. Sampling and Questionnaire Design

Interviewees were selected based on a combination of convenience, snowball, and expert sampling methods. The author leveraged existing networks through the National Disaster Preparedness Training Center at the University of Hawaii, the Coastal States Organization, and FEMA to identify appropriate contacts and interviewees. The study sought practitioners either directly involved or intimately knowledgeable of coastal management and hazard mitigation planning and adaptation in each jurisdiction, with the goal of interviewing at least one coastal manager and one hazard mitigation planner per jurisdiction. Initial contacts sometimes led to referrals to more appropriate individuals. In total, thirteen (13) interviews were conducted – twelve (12) virtually over Zoom, and one (1) in-person – between November 2022 and March 2023. Table 11 shows the characteristics of interviewees by island, region and role. Audio recordings facilitated interview transcription and analysis. This approach was approved by the University of Hawaii Institutional Review Board (IRB).

Table 11 - Interviewee Descriptors (n = 13)

Island		**Region**		**Role**	
USVI	*3*	*Caribbean*	*5*	*CZM*	*7*
Puerto Rico	*2*	*Pacific*	*8*	*HM*	*6*
Guam	*2*				
Am Samoa	*2*				
CNMI	*2*				
Hawaii	*2*				

Interviews were semi-structured, in that there were general questions and topics that provided a base structure for the interview, but there was flexibility in the order of questions and direction of the

discussion. Interview questions and topics were selected based on the framework and research questions. This study primarily aims to address research question #3: *What are the planning challenges for coastal adaptation in island jurisdictions, and the capacities needed to overcome them?* Questions were focused on the planning processes and context relevant to the development of coastal management plans and hazard mitigation plans, with the objective of identifying challenges and best practices in consideration of the coastal adaptation principles. The baseline question and topic list in Table 12 aimed to navigate the discussion from the general coastal governance context of the jurisdiction; to an in-depth discussion of the processes of developing the respective plan (coastal management or hazard mitigation); to a broader discussion of general adaptation priorities, challenges, and strategies in the jurisdiction. Questions were also asked regarding federal assistance, disasters, and innovative approaches.

Table 12 – Interview Questions/Topics

Coastal and shoreline governance
CZMA 309/HM Planning processes
CZMA 309/HM Planning challenges
Alignment with other plans
Adaptation priorities
Adaptation strategies
Adaptation challenges
Island context
Federal assistance
Disaster recovery
Innovation

3. Qualitative Analysis

Interviews were transcribed and analyzed using Dedoose qualitative analysis software. Transcripts of each interview were reviewed and coded by the author to identify emergent themes in the data. The coding procedure employed a mix of deductive and inductive coding following methods described in Linneberg and Korsgarrd (2019) and Lewins and Silver (2007). Coding entailed three cycles of coding and categorizations as shown in Figure 11. Following a deductive approach, preliminary parent codes were pre-determined based on the questions asked of interviewees. Subcodes were determined inductively as the data were reviewed and subtopics were identified. Subsequent coding cycles refined and re-classified codes based on similarities and patterns observed in the data and several factors – the coverage of the code across interviews (percentage of interviews the code was identified in), total code count (number of times the code was applied), the relation to the research question, the relation to coastal adaptation principles, and the relevant planning dimension (outputs, processes, context) – ultimately focusing on codes that were applied over the majority of interviewees, were applied repeatedly, and were most relevant to the research questions and adaptation principles. The codes were finally organized based on *Context*, *Planning*, *Adaptation*, *Challenges*, and *Innovations*. The complete code list is found in Appendix C.

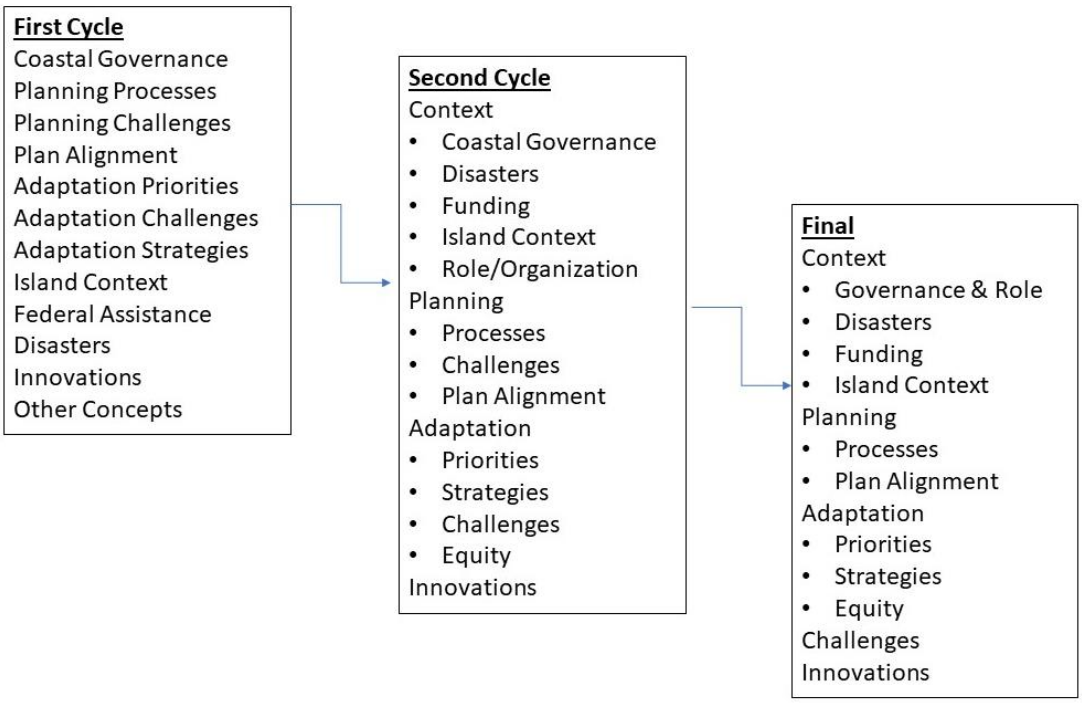

Figure 11. Evolution of coding scheme through coding cycles.

4. Validity and Potential Biases

There is an inherent subjectivity in coding for qualitative research (Skjott Linneberg & Korsgaard, 2019). The inductive elements of the coding process help to eliminate some bias by letting the findings be grounded solely on the data (Corbin & Strauss, 1990), but judgements based on values and characteristics of the researcher remain when deciding on codes to assign and further analyze (Skjott Linneberg & Korsgaard, 2019). It is important in qualitative research to acknowledge and disclose these characteristics to ensure transparency and provide readers an understanding of the validity of the data (Adu, 2021; Elliott, 2018; Skjott Linneberg & Korsgaard, 2019).

Although the coastal adaptation principles and evaluation framework is grounded in literature, the author's values and experience as a coastal planner and engineer may have influenced the research design and analysis in terms of the selected interview topics and codes. The author's island residence, desire to make coastal communities more resilient, the knowledge of natural systems, and experience with disaster research have instilled certain values and awareness in the researcher related to priorities, gaps and strategies for adaptation. The author has attempted to counter potential bias of these characteristics through the combined deductive/inductive approach to the research, using the expertise and experience to guide discussions and initial coding, but allowing the findings to emerge directly from the data.

D. Results

Several themes emerged from the practitioner responses, organized in Table 13 under the following categories: the *contextual factors* that influence adaptation planning in the islands, the *planning processes and integration* between mechanisms, the *adaptation priorities and strategies* considered across the islands, the explicit *challenges* for planning and adaptation, and the examples of *innovations and successes* related to adaptation planning. Although individual islands and practitioners may have unique perspectives and experiences, the themes emerging in these categories represent those in common across most interviewees, those that emerged repeatedly in the data. The findings described in the following sections report on the most prevalent and cross-cutting themes within each category, while providing supporting excerpts from interviews. Excerpts are labelled with only the role of the associated interviewee (Coastal Manager or Hazard Mitigation Planner) to maintain anonymity.

Table 13 – Emergent Categories and Themes*

Category	Themes
Contextual Factors	• Perceptions of climate impacts are driven by experiences and observations. • Fragmented governance structures in the coastal zone present both advantages and challenges. • Islands have shared disaster experiences that can foster knowledge exchange and adaptation in recovery, although neither is happening formally across all islands. • **Islands rely heavily on federal funding, but struggle with access and execution.** • Unique island contexts include topographic and geographic constraints, cultural value of natural systems, and location within a shared regional context.
Planning (CZM & Hazard Mitigation Planning) Processes and Integration	• The mandated objective of the plan is an important influence on plan content. • Most plans are developed either partially or fully by contractors. • Stakeholder engagement can be improved. • There is a recognized need to integrate land use planning. • **There is an inherent connection between CZM, Hazard Mitigation, and Adaptation.** • Integration requires effort-intensive engagement to be fruitful.
Adaptation Priorities and Strategies	• **Priorities are driven by observed changes and impacts, with the most urgent being shoreline erosion and flooding.** • Priorities also focus on the need to better balance development, infrastructure, and natural systems. • Nature-based solutions are desired, but usage is so far limited. • Retreat is a recognized need but is difficult on islands. • Strategies require robust education/outreach to increase awareness of risks and benefits of alternative solutions. • The issue of equity in adaptation planning is linked to vulnerability and funding.

Highlighted themes are most prevalent within each category.

Table 13 (Continued) – Emergent Categories and Themes*

Category	Themes
Planning and Adaptation Challenges	• Planning cycles can encourage planning but inhibit robust planning processes. • **There is an urgent need to increase capacity to meet planning and adaptation needs.** • The lack of access to high quality data hinders effective planning. • Having a plan does not guarantee implementation. • Engagement is the most difficult yet important part of the planning process. • Public perception is an influential barrier to adaptation efforts.
Innovation and Successes	• **Islands are finding ways to leverage other resources to fill capacity gaps.** • Having a dedicated planning coordination agency helps with engagement and plan alignment. • Mandated comprehensive development guidance is an effective tool for alignment and incorporating adaptation into recovery. • Natural systems (coral reefs) are legislatively recognized as critical infrastructure, having implications for funding and conservation.

Highlighted themes are most prevalent within each category.

1. Context - Islands rely heavily on federal funding but struggle with access and execution.

Many interviewees referred to the low levels of funding for their programs (both coastal management and hazard mitigation) in the state or territory budget, with most of their operational funding coming from federal sources (*Excerpts 1, 3*). This may be due to the smaller populations, governments and economies across the islands relative to their continental counterparts. The reliance on federal funding is present for daily operational duties, as well as program improvements and adaptation projects. Low levels of state or territory funding for coastal management and hazard mitigation programs and their reliance on federal funding presents several challenges for these programs. These include limits on staff pay and sizes (*Excerpts 2, 3*).

1) *We get approximately $250,000 from the state. It's a very disproportionate share. It's about 10% of my budget. Annually.* ***(Coastal Manager)***

2) *We've not been able to accommodate that [county] request [for state support] based on kind of slow incremental increases in federal funding that would support a full position jump. And we had previously reallocated that funding to other warm body positions. And so in order for us to reassess those*

county contracts and add another county [position], if we're going to be fair, we would likely reduce one warm body in each county. ***(Coastal Manager)***

3) *So our director is trying to see if maybe salaries can be increased [through grants] to give people an incentive to stay because we're primarily funded by federal grants. And it's a funny thing because we should be kind of semiautonomous, because we are 80% [federally funded], but we're still fully under the executive branch, so it makes it a little difficult to navigate.* ***(Hazard Mitigation Planner)***

Although islands rely on federal funding to operate, acquiring that funding is not a simple task with many interviewees highlighting challenges they've encountered, such as competing for grants with higher-capacity jurisdictions (*Excerpt 4*) and not being able to meet match requirements (*Excerpt 5)*, both of which are driven by local budget contributions and capacity. Many continental jurisdictions with higher state government revenues have more resources and capacity for developing competitive proposals for federal grants. Island jurisdictions also often deal with higher costs of labor and materials, making it difficult to meet benefit-cost standards for federal grants (*Excerpt 6*). In some cases, the federal funding provided is not sufficient to make lasting change (*Excerpt 7*).

4) *… a national competitive grant where you got to compete with the rest of the world, or at least the US or at least California, let's just keep it at California, because those guys always win.* ***(Hazard Mitigation Planner)***

5) *The problem is that we don't have match, even if it's a small match. The state does not fund us very much. We rely on federal funding. And so unless FEMA, and I'll tell this to everybody, unless FEMA and NOAA create some sort of memorandum of agreement to waive the match or something, we're not able to do that currently unless the state gives us more funding.* ***(Coastal Manager)***

6) *And I think the cost benefit analysis…I think it needs to be revisited for the islands because of our costs of shipping and construction being so high. It just is very hard to get positive ratios.* ***(Hazard Mitigation Planner)***

7) *… while the issues are quite complex and very vast, the money that we have in the 309 really is not sufficient.* ***(Coastal Manager)***

These island challenges bring up issues of equity when competing and compared with continental jurisdictions that have higher capacity, raising questions of where federal resources should be focused. One interviewee highlighted this issue of funding equity while expressing frustration with proposals being rejected (*Excerpt 8*).

8) *I think we should be given the mercy rule… like you want to talk diversity, equity, inclusion...equity would be giving us, but we didn't earn, because we need it. You know, like you've got a problem with my application. Don't say no. Fix it. Give us what we need to get between here and the finish line. I really don't know what other way you could.... Who else do you think needs the equity? You know, it's us.* ***(Coastal Manager)***

2. Planning Processes and Integration – There is an inherent connection between Coastal Management, Hazard Mitigation and Adaptation.

Interview responses highlighted connections between CZM, hazard mitigation and adaptation. Researchers have recognized the connections between adaptation and hazard mitigation (Lyles et al., 2018; Matos et al., 2022) and suggest land use for hazard reduction can be a powerful tool for adaptation (Berke & Stevens, 2016; Lyles et al., 2018). Hazard mitigation planners interviewed also highlighted this connection between mitigation and adaptation (*Excerpts 9, 10*) and the potential that the hazard mitigation plan (*Excerpt 10)* and land use (*Excerpts 11, 12, 13*) can play, even if they're not fully leveraged so far. Land use was broadly recognized as an appropriate strategy, but beyond land acquisition, few interviewees mentioned specific land use tools, such as setbacks, which are being employed. This could be due to the difficulty of changing land use laws (*Excerpt 14),* as well as the difficulty of applying broad land use strategies at the site scale (*Excerpt 13)*. It may also relate that even though land use can be encouraged as a mitigation measure by the planning team and the hazard mitigation plan, ultimately mitigation actions are often chosen based on leadership priorities (*Excerpt 15)*. There are specific challenges related to land acquisition for adaptation in the context of retreat, which will be discussed in the *Challenges* section.

9) *So I kind of see the climate adaptation as a segment of [hazard] mitigation that may not be that popular. But I think the challenge is when you look at it from kind of my background and experience, you start overlaying the other hazards on top of it. So a lot of the adaptation in the climate group, they're not taking into geologic hazards or those type of hazards.… So I consider it a subset.* ***(Hazard Mitigation Planner)***

10) *So it [the hazard mitigation plan] has a potential, like the plan itself, the things that it addresses....It provides access to funding. Because of that, it can be a very good tool for adaptation. Well, whether or not that happens is kind of you know, it goes down to the implementation side of things, right?* ***(Hazard Mitigation Planner)***

11) *Even though the mitigation plan falls into emergency management, it's really a planning, it should be with planning and land use more than a disaster focus. You know, sometimes people think, oh, you pull out your plan when you have a disaster like No, you use it every day so you don't have a disaster.* ***(Hazard Mitigation Planner)***

12) *I personally consider the strongest mitigation measures are silent, it's building code and land use. They tend not to be the most attractive topics, but they're kind of silent and behind the scenes.* ***(Hazard Mitigation Planner)***

13) *Land use planning is a very big, holistic tool that recommends actions. And recommends how we have to forward any strategies for the better use of our land… we have to start to thinking that the land use is like a big guideline and it doesn't fit in the same manner in different places.* ***(Hazard Mitigation Planner)***

14) *So ideally, the legislature would be like, yes, this is a good plan. And we passed this in a bill and we give you two years to change the zoning, to change the rest of the laws and regulations, rules and regulations that since we adopted this, we would need to change this, that and the other thing in order to be in compliance with this*

newly adopted plan. But it is not changing the rules and it is not changing the code. ***(Coastal Manager)***

15) *I mean, you do the risk assessment, you do the capability assessment, but ultimately, the Hazard Mitigation Council is going to pick their projects.* ***(Hazard Mitigation Planner)***

Interviews highlighted the land use role that coastal management programs play across the island jurisdictions, with many having lead permitting and regulatory roles (*Excerpt 16, 17)*, or having comprehensive planning authority (*Excerpt 18)*. This underscores the potential for coastal management programs to align with hazard mitigation efforts or coordinate collective adaptation on islands.

16) *We mention the permit review system [managed by CZM] and then we keep bringing it in bigger and bigger and bigger because that is what matters. And it was a priority of the state hazard mitigation officer, and she worked so hard for years to get on to the review board. And I believe now that she is there as like in an advisory role, but not in a voting role.* ***(Hazard Mitigation Planner)***

17) *I think it's holistically working with the Division of Planning and Natural Resources and making sure the zoning is done right with permits and making sure that we take that into account holistically and take all hazards into account so that we can try to mitigate that coastal and shoreline issue because people will be cut off.* ***(Hazard Mitigation Planner)***

18) *…the Coastal Management Program is responsible for the land and natural resources planning for the Bureau, which is primarily most of the elements of the comprehensive plan that's required to make. …And so this central planning function gives us that. And through agencies whether private or public, when they're looking at their planning, it has to harmonize with these comprehensive development plan controls that we have…. So we're able to bring people together through our planning authorities and it seems like we're the only unit that's in the government, that has that charge of looking at the fragmentation, finding ways to address those and bring people together. So it's definitely heavy on the coordination and that's our core strength is our network and we have the mandates to do that.* ***(Coastal Manager)***

While these coastal management functions show the potential for sectoral integration, this integration is happening to some degree in practice, but can be improved (*Excerpt 19*), especially when it comes to adaptation planning (*Excerpt 20*). Presently coordination occurs mainly through referencing hazard information or risk assessments in respective plans and soliciting input on plan reviews and stakeholder surveys. Coordination can also occur through interagency councils or forums (*Excerpt 21*) but requires active participation to be fruitful (*Excerpt 22, 23, 24*). Purposeful engagement is critical for aligning objectives and strategies, but isn't occurring as much as it should, possibly due to the limited capacity and competing priorities facing practitioners (*Excerpt 25).*

19) *I think there needs to be more alignment. I'm not saying it's not there, but there's room for improvement, especially with us with DPNR, who's actually the ones that are doing the land use plan.* ***(Hazard Mitigation Planner)***

20) *I do think there's an opportunity now with some of the climate adaptation and sea level conversations going on to align those with hazard mitigation.…I haven't seen*

that alignment that the mitigators they're doing one thing and the climate groups are doing another… They're [adaptation] actually being done in whole new documents. The counties have set up their own climate adaptation kind of functions in their government and they are doing hazard reduction in those documents, which I give them kudos for. But if they see the FEMA funding as the option, that has to be incorporated in their county plan or in the state plan. ***(Hazard Mitigation Planner)***

21) *The choice was made [to incorporate a hazard mitigation strategy into the 309] because we sit on the state multi hazard mitigation forum itself and the analyst that really was assigned to that recognized that the process also was very similar in terms of an assessment of risks to the state, including a coastal hazard section and rather, and it was vetted by over 60 participants through with many, a large variety of agencies, so that is where we have an alignment.* ***(Coastal Manager)***

22) *think just having the various partners with bandwidth and resources being able to kind of embed themselves so the state hazard mitigation forum is a very diverse group of individuals, the Office of Planning Sustainable Development at the state level because a lot of the climate adaptation pieces and so there has been a good cross-pollination among those.* ***(Hazard Mitigation Planner****)*

23) *it's critically important that we do have the next state hazard mitigation plan reflect our what I think are our true vulnerabilities which has been missed in the past plans. And it has been missed because I don't think the agencies have been actively involved as they could. I talked about earlier, how these agencies are overwhelmed with not only their day-to-day management, but the violations, just the immense amount of work.* ***(Coastal Manager)***

24) *I think just being more directly involved and, I don't want to say inserting the coastal program's priorities, but just ensuring that, you know, the overall objective of the 309 is adequately captured. You know, especially when it comes to the coastal hazards update.* ***(Coastal Manager)***

25) *So it may be worthwhile to look at it as kind of a year-long, okay, this is how we're going to try to integrate and be coordinated and consistent between the planning bodies and the planning documents, but with very limited resources, at least out here in the state, in these islands, it's very hard to do with all the other demands.* ***(Hazard Mitigation Planner)***

3. Adaptation - Priorities are driven by observed changes and impacts, with the most urgent being shoreline erosion and flooding.

When asked what their priorities for adaptation were, responses could be distinguished between priorities related to hazards and those related to managing assets, although the connections between hazards and the assets along the shoreline became clear. Regarding climate hazards, interviewees overwhelmingly prioritized shoreline erosion and flooding (*Excerpts 26, 27, 28, 29*) – attributed to both sea level rise and extreme events. These priorities seemed to be driven by personally observed changes in their environment, such as beaches disappearing and property damage. The impact of these hazards on development was evident in interviewee responses, whether it is impacts to housing (*Excerpts 26, 30, 31*) or infrastructure (*Excerpts 27, 29, 31*).

26) *Shoreline adaptation and inundation I think is a really high priority and has elevated, I think, into a highly visible priority now, most recently for the homes that have fallen into the ocean.* ***(Coastal Manager)***

27) *Flood and drought and intensified storms are climate change that are here and are definitely going to get worse….But if we had to start tackling something sooner rather than later, it would be flooding. Also, I think that's what's most felt because of the infrastructure being poor…. but I think the biggest risk that we stand to lose economically… is shoreline loss and erosion, which has a big compound influence.* ***(Coastal Manager)***

28) *I'll just say this, me growing up here, I've seen the change in the beaches, if that makes sense, because I grew up here. So my favorite beach, the shore is not what I remember. The water is coming further inland and then the water is deeper. It's dropping. And that beach was known for being a very shallow beach, you know, where you could go and kind of young kids can play.* ***(Hazard Mitigation Planner)***

29) *…And I see that at all the beaches. And I'm noticing the roads are giving away and places where restaurants are, it's eating out.* ***(Hazard Mitigation Planner)***

30) *Because with the Territory's topography that's the key thing. Sedimentation on reefs, coastal development, building too close to the shore so that when we do have storms, we're ending up with homes in the water with severely eroding beaches.* ***(Coastal Manager)***

31) *So shoreline adaptation certainly is a very big issue because so much of our low lying, our coastal plains and housing, of course, all of the development that was easily developed because it's low lying and flat, including our critical infrastructure. Airports, subsurface infrastructure, roads, etc..* ***(Coastal Manager)***

This points to the importance of managing development, with interviewees stressing the need to balance development with natural resources (*Excerpts 32, 33*). Development on islands is often concentrated in hazardous areas, either along the shoreline or in low-lying flood zones. Pressures to develop arise due to military expansion, tourism demand, and the desire for economic growth – all with limited land availability (*Excerpt 34*). This development pressure challenges antiquated regulatory and land use structures that don't adequately address erosion or sea level rise and take great effort to change and update. The need for updates is recognized among interviewees, with several coastal programs actively modifying their permitting processes or policies to address resilience issues. These changes are slow however, and often need legislative approval to take effect (*Excerpt 14*). Growth management strategies also require reliable data regarding climate hazards, a scarcity of which exists among the islands as noted by many interviewees. Some of the regulatory changes include changes to encourage the use of nature-based solutions, an adaptation strategy that is of great interest among the islands. This interest in adaptation and nature-based solutions is spurred by close connections to the natural environment on islands and the place it has in island culture (*Excerpt 28, 35*); however, there are concerns that not enough attention is being given to shoreline issues and the use of nature-based solutions has been minimal due to limited expertise and guidance (*Excerpt 36*).

32) *We have a clear need for looking at how we're going to try to retain natural resources, balancing the need for societal amenities with balancing the needs for protecting, especially our marine resources, which are the backbone of our GDP.* ***(Coastal Manager)***

33) *I think by finding, carving out some time to see how do we integrate ideas, tools, best practices, technology to help us become resilient, to help us adapt to that change in these very special areas in our coastal zone would be something very beneficial to help guide the long term development of our island.* ***(Coastal Manager)***

34) *So we want it [development], but we're afraid to have it because it causes, it's a balancing act. It's hard to balance that if your island is very small.* ***(Hazard Mitigation Planner)***

35) *I talk about shoreline loss a lot because I think that's what hits everybody. Everybody who lives here wants to go to the beach, everybody who gets off if you get off. And for tourism, whether it's an airplane or a cruise ship, whether you're here for 6 hours or six days or six weeks, whether you're a Virgin Islander, and so were your grandparents, grandparents or you just moved here yesterday, you want to go, whether you're old or young, you want to go to the beach. It's our economy. It's where people socially gather. It's part of the social fabric and the culture of people… I feel like shorelines is the thing that we're not going to pay attention to till it's too late.* ***(Coastal Manager)***

36) *The only challenge that I saw was knowledge. We talk a lot about the idea of natural based solutions, but there wasn't a lot of knowledge or know how to do it.* ***(Hazard Mitigation Planner)***

4. Challenges - There is an urgent need to increase capacity to meet planning and adaptation needs.

The most noted challenge among interviewees was overwhelmingly that of the lack of staff capacity for planning and adaptation efforts across the islands. This is a much cited challenge among island adaptation literature (Kuruppu & Willie, 2015; Mcleod et al., 2019), and is a concern when considering the sometimes disproportionate climate change vulnerability of islands. The noted capacity challenges among interviewees are driven by both bandwidth (i.e., the capacity to handle multiple issues at once) and expertise. Many interviewees cited that daily demands test the bandwidth of short-staffed teams to their limits, affecting the ability to enforce regulations (*Excerpt 37*) or focus on strategic planning efforts (*Excerpt 38*). This bandwidth is further taxed during disaster events, when government personnel are struggling to manage disaster funds and provide services to the public while dealing with their own personal recovery challenges. Personnel are often pulled to other assignments to support recovery efforts, further taxing the capacity of teams to meet operational demands (*Excerpt 39*).

37) *So then the agencies are having to not only review the permits but make sure that they're out there monitoring. And then have to deal with the stop orders and the amount of work that comes with stopping those projects because they've found*

*violations. And it's a continual thing...That certainly is very challenging. And it's not that the agencies are not doing their job it's just there's just so much, there's just agencies are just overwhelmed. And I think that every single partner that we have, they have great staff who really care and they're just under capacity**. (Coastal Manager)***

38) *And oftentimes, I don't even get a chance to participate in the planning efforts very well, because I'm looking at human resource challenges. I'm looking at, compliance challenges. I'm looking at everything else. So often times too, even as the director, I have a difficulty going into it, looking at the strategic direction of the division, looking at policies that we may need to change….We're always putting fires out. And it does take away, you know, from that strategic view that needs to occur. **(Coastal Manager)***

39) *So whenever there's a disaster, our GIS folks are always detailed to work at the EOC to provide mapping support, data support, generate reports and also go out to pinpoint to collect data of all the houses that were impacted or affected by the disaster. **(Coastal Manager)***

This bandwidth issue is driven by funding gaps (as noted in Section D.1) and challenges with recruiting and retaining personnel. Recruitment is hindered by government pay scale limits (noted in Section D.1) and competition from the private sector (*Excerpt 40*). Recruitment challenges also affect the level of expertise available within island planning teams. Beyond the competition from higher paying organizations, there is a need to develop the coastal hazards planning workforce across the islands (*Excerpts 41, 42*). The lack of capacity results in many planning efforts being contracted to outside consultants, which further inhibits in-house capacity development for future planning efforts (*Excerpt 43*).

40) *It is much more attractive for someone that has a couple of years of experience to go work for a large consulting firm and make a lot more money potentially. And mitigation is very technical. So just having the professional resources to manage that, the kind of the band of projects is also a challenge*. ***(Hazard Mitigation Planner)***

41) *But we need a pipeline of coastal planners. **(Hazard Mitigation Planner)***

42) *We don't produce those kinds of students out here. **(Coastal Manager)***

43) *I think that is the connection, what we do in terms of coastal management, in terms of coastal hazard risk reduction is very interconnected with the standard state mitigation planning efforts and it is a missed opportunity to see these plans being bid out every five years when there are opportunities to build internal capacity to have planners in-house working on these and the plan updates and implementation to help guide and ensure that the projects are avoiding mal adaptation outcomes. **(Hazard Mitigation Planner)***

5. Innovation and Successes

Despite the challenges, or perhaps because of them, islands can be “hubs of innovation” and successful examples of adaptation (Mcleod et al., 2019) and resilience (Harangody et al., 2022). The study data confirmed this, with interviewees sharing innovative approaches and successes that can serve

as transferrable lessons across the islands. The capacity challenge in U.S. Island jurisdictions is evident and urgent; however, the examples below showcase ways in which coastal managers and hazard mitigation planners are leveraging existing talents and resources to help fill capacity gaps and advance adaptation planning on their islands. These include building strong relationships with community organizations to help with engagement and education (*Excerpt 44*), leveraging academic institutions for technical and planning capacity (*Excerpt 45*), using federal technical assistance to gather new hazard data and bolster grant applications (*Excerpt 46*), and leveraging existing planning processes to maximize stakeholder engagement and planning bandwidth (*Excerpt 47).* Associated islands are provided with the excerpts in this section, to facilitate further dialogue and knowledge sharing across islands if the interest exists.

44) *We have a lot of help with nonprofit organizations at the different levels and people in the community are open to receive that type of knowledge that the nonprofit brings to the community, to the people, to the government. So this is a relationship that we have to continue… And we don't to lose this type of help.* ***(Hazard Mitigation Planner, Puerto Rico)***

45) *The positive angle of this effort was that for the first time the academia as well and other sectors, with more subject matter experts…were included and were involved in this process….* ***(Hazard Mitigation Planner, Puerto Rico)***

46) *If you add up the technical assistance that we're able to broker, I think it's more than our CZM budget…So we use the technical reports to then build stronger proposals to address whatever issues that we're working on. And then it also bodes well with FEMA, when they see us that we're working with the [Army] Corps, it makes our application much stronger.* ***(Coastal Manager, Guam)***

47) *What we've done is we have identified our planning process that occurs sort of in parallel to the 309 strategy development….And that plan was developed with a public outreach component. So we are fairly confident that it reflects the concerns broadly through the state.* ***(Coastal Manager, Hawaii****)*

Besides capacity-filling measures, there were examples of successful approaches for facilitating adaptation. Comprehensive planning guidance can help to align planning efforts and hold projects to a common standard that meets island objectives for sustainable development or adaptation. An example of this is the Commonwealth of the Northern Mariana Islands Comprehensive Sustainable Development Plan (2021), which is led by the Office of Planning and Development (OPD) and incorporates all planning efforts on the island and ensures adherence to CNMI's Smart, Safe Growth Guidance (*Excerpt 48*). The guidance outlines principles for sustainable development, climate adaptation and hazard mitigation. The guidance and associated scoping tool have been used to assess proposed Typhoon Yutu recovery projects against those principles to incorporate adaptation objectives into recovery (*Excerpt 49*). Another successful example to support adaptation is the official recognition of coral reefs as critical infrastructure in Puerto Rico (*Excerpt 50*). Considering the storm protection, economic, and ecological benefits of coral

reefs, this recognition will help to conserve natural systems and promote nature-based approaches to adaptation.

> 48) *But at the end of the day, all of the plans that we support that are ultimately incorporated into our comprehensive plan need to be consistent with our smart, safe growth principles, which include public participation and transparency and community engagement.* ***(Hazard Mitigation Planner, CNMI)***
>
> 49) *So for the Yutu recovery, every single one of the projects. Something like $70 million of projects went through this scoping tool and we did re-scope some of them using that guidance and actually used those assessments to support requests to FEMA that was granted for a match waiver, which was incredibly helpful and well received. So it's been a powerful tool. HMGP has been using it. Public assistance, if we're being honest, perhaps not as robustly, although we're still working on that.* ***(Hazard Mitigation Planner, CNMI)***
>
> 50) *Puerto Rico drafted into law having corals as critical infrastructure. And we've had in the All-Island committee requests from other jurisdictions to see the writing and so we forward that law. So I think that's something that other jurisdictions are seeing as innovative.* ***(Coastal Manager, Puerto Rico)***

The importance of sharing experiences and best practices was emphasized by one interviewee (*Excerpt 51*), stressing the commonalities across the island regions and the benefits of knowledge-exchange. Although adaptation is local and place-based strategies are encouraged, the similarities across islands provide opportunity for sharing lessons learned to maximize the limited resources and capacities available to them.

> 51) *Because we have the same problems. We have the same hurricane seasons. We have the same heat month. So it is it is essential that we share the best practices and the initiatives and try to use that work. [Maybe] our strategy doesn't work here, but with another colleague or practitioners in the Caribbean it will help.* ***(Hazard Mitigation Planner, Puerto Rico)***

E. Discussion

1. Application of the Coastal Adaptation Planning Evaluation Framework

This study applied the Coastal Adaptation Planning Evaluation Framework primarily focusing on the portions related to planning *processes* and *context* to answer *Research Question #3*, as shown in Figure 12. Questions and interview topics were not explicitly structured around the coastal adaptation principles, but indicators of the principles emerged in the data. This shows the flexibility of the framework, and its application in purely positivist or deductive approaches such as a plan quality evaluation (Connell & Daoust-Filiatrault, 2017; Norton, 2008), or through more organic approaches such as inductive coding and qualitative analysis.

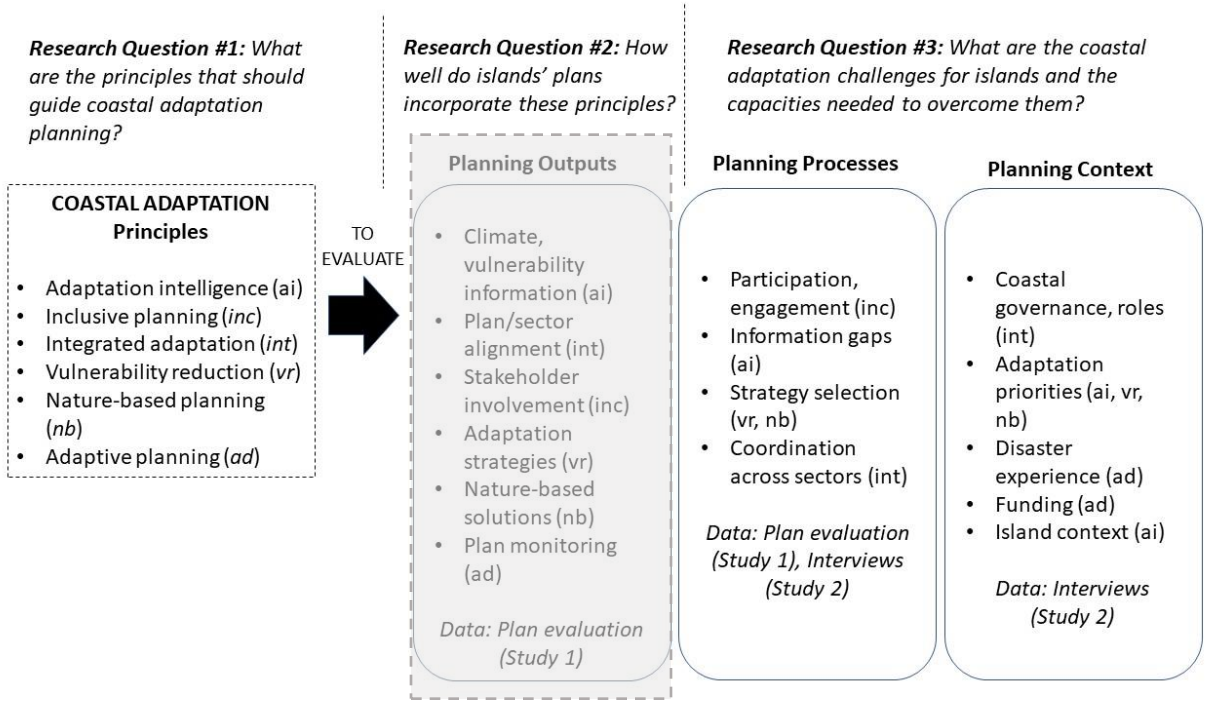

Figure 12. The Coastal Adaptation Planning Evaluation Framework applied to the qualitative study.

The data can reveal some measure of how the principles are applied in ongoing planning efforts and processes across the jurisdictions. For example, responses elaborating on planning processes often make mention of those involved in planning, how they were engaged, and difficulties with that engagement. These are all indicators of the *Inclusive Planning* principle; however, interview responses can expand on the challenges with or reasons for engaging certain stakeholder groups, where plans themselves may not. Interviews can also provide insights into the nuances and challenges related to information gaps, selecting adaptation strategies and coordinating across sectors; which relate to the *Adaptation Intelligence*, *Vulnerability Reduction*, and *Integrated Planning* principles, respectively. Similar measures can emerge from assessing planning context. For example, funding challenges and disaster recovery priorities described during interviews can provide an indication of implementation challenges or opportunities to incorporate adaptation in recovery, both related to the *Adaptive Planning* principle.

To the point of principle measure, qualitative data broadly revealed a similar pattern to the plan evaluation in that the adaptation principles are not fully achieved in current planning processes. This is partially driven by contextual factors such as coastal governance roles, funding, and specific island context. Interviews can go beyond the measure of 'plan quality' and begin to explore the reasons behind that quality, or more specifically in this case, the reasons why coastal adaptation planning principles are not fully achieved. The reasons are attributed to the slew of challenges facing island jurisdictions as they plan for climate change, challenges that confirm some of the barriers identified in the adaptation literature.

2. Confirming Adaptation Barriers across Principles

Adaptation Intelligence challenges noted in interviews related to the lack of data at necessary scales across the island jurisdictions. Information gaps are well-documented across the adaptation literature, with both the lack of data and the capacity to analyze it being barriers (Measham et al., 2011; Moser & Luers, 2008; Tribbia & Moser, 2008). For islands, the lack of data can be especially prohibitive as the natural variety of island coastlines necessitate site-scale information for adaptation, and there is often a lack of technical or financial capacity to generate the necessary data (Kuruppu & Willie, 2015). Integrating local and traditional ecological knowledge into planning processes can help fill these information gaps (Harangody et al., 2022; Mcleod et al., 2019; Mercer et al., 2012), the potential of which in U.S. islands deems further investigation.

Inclusive planning challenges highlighted by interviewees related to the labor-intensive nature of engagement, the difficulty managing public perception and the willingness of stakeholders to participate. Much of this is driven by the capacity of coastal management and hazard mitigation staff and their counterparts to purposefully engage and coordinate with other stakeholders, a capacity that is reduced by small staff and limited bandwidth. The pressures of operational demands and competing priorities has been identified as a barrier to adaptation elsewhere (Measham et al., 2011; Moser & Luers, 2008). This affects the ability to conduct education and outreach activities to better increase the public awareness of climate impacts and solutions. Public perception was noted as a significant barrier to adaptation progress in the U.S. islands, with many underestimating climate risk and misinterpreting the necessity of adaptation. This gap between perception, awareness and actual risk and necessity for adaptation has been found in other island studies (Betzold, 2015; López-Marrero, 2010; Mortreux & Barnett, 2009).

Integrated Planning challenges also relate to the capacity to engage partner agencies, as noted above and in reported in Section D. Without the bandwidth or staff to regularly coordinate with partners, the chance of alignment across planning sectors decreases, and adaptation tends to occur in siloes. The tendency towards sectoral approaches to adaptation has been found by others (Baker et al., 2012), and specifically across SIDS (Kuruppu & Willie, 2015). The deficiencies in *Integrated Planning* also relate to the way in which information is disseminated across agencies and the perceived relevance and clarity of the information to each stakeholder. As noted by one coastal manager, plans and reports disseminated across agencies without any kind of synthesis or communication follow-up have little chance of being read let alone utilized by others. The need for information to be disseminated in a manner and format that is relevant to practitioners has been documented in the coastal management field (Tribbia & Moser, 2008).

The *Vulnerability Reduction* and *Nature-Based Adaptation* principles are indicated by the types of strategies employed to reduce the vulnerability of development, infrastructure, and people living in hazardous areas. Interview responses confirmed minimal use of land use policies and nature-based solutions for adaptation, although both were recognized as important and needed in the jurisdictions.

Land use has been shown to be underutilized in hazard mitigation plans, and is driven by involvement of land use planners in the planning process (Lyles et al., 2014). The barriers to their use reported in the data included challenges with managing development pressure and growth, the public understanding of the solutions, private property rights and ineffectiveness of existing regulations and policies. Development pressure is a commonly reported challenge in the literature, with this pressure leading to a preference for hard shoreline protection (Abel et al., 2011; Klöck & Nunn, 2019). Development management controls can have a significant influence on adaptation (Hurlimann et al., 2014), but current controls have been shown to be ineffective at reducing risk or conserving beaches in the islands (Kittinger & Ayers, 2010; Summers et al., 2018b). Interviews reported that capacity was a major obstacle in managing development and nature-based solutions, with limited bandwidth available for enforcement or expertise for implementing alternative solutions to hardening, such as nature-based solutions, perhaps explaining the lower plan evaluation scores for these principles in Chapter 3.

Adaptive Planning challenges noted in the interviews related to funding and disasters. Successful implementation – an element of adaptive planning – requires the identification of and access to consistent funding sources to support adaptation, a challenge noted by interview responses. Financial capacity is an often cited barrier in the adaptation literature across islands (Betzold, 2015; Kuruppu & Willie, 2015) and other settings (Baker et al., 2012; Moser & Ekstrom, 2010). Disasters offer an opportunity to learn from previous development flaws and implement adaptation, due to the influx of federal funding made available for recovery. Based on interview responses, most islands don't seem to be taking advantage of recovery as a means to adaptation, citing the complexity of funding processes and requirements, the time required to design and acquire buy-in for improvements, and the social and political pressure to see physical recovery as quickly as possible. These recovery pressures have been likened to a development process compressed in time, creating a tension between recovery speed and deliberation over making changes (Johnson & Hayashi, 2012; Olshansky et al., 2012; Platt & So, 2017). Others have also observed that windows of opportunity opened by disasters are not fully leveraged (Abel et al., 2011; Lyles et al., 2014; Olshansky, 2005; Platt & So, 2017).

3. Capacity Feedbacks as Cross-Cutting Hurdles or Accelerators

A common theme across the barriers described above is that of capacity – the technical, physical and financial capacity of coastal managers and hazard mitigation planners, especially government planners, has widespread effects on their ability to advance adaptation in their jurisdictions. Therefore, this study implies that the most important action that can be taken to facilitate adaptation in the islands is prioritizing staff increases and workforce development. This may seem obvious and a common gripe in any industry, but the qualitative data highlights why this is especially important in this coastal adaptation context. Based on the responses from practitioners on the ground, capacity is at the heart of many of the challenges islands face, and conversely can be at the heart of any progression of adaptation efforts. Capacity can have a powerful positive or negative influence across most adaptation aspects and planning

principles, creating either positive or negative feedback loops. Capacity, then, can be an ever-growing hurdle or accelerator for island adaptation.

As an example, staff capacity (i.e., bandwidth) was cited as a challenge for engagement with stakeholders and enforcement of development regulations. This can lead to risky development practices and degraded ecosystems which in turn increase the risk of coastal development. Poor engagement can also lead to poor integration across sectors and result in planning inefficiencies at best and maladaptation at worst. Without the capacity to engage stakeholders or manage federal funding, recovery can be rushed without incorporating hazard mitigation or adaptation into rebuilding, failing to reduce the risk the damaged property faced to begin with. On the other hand, increasing capacity to educate and engage stakeholders and enforce regulations helps to prevent risky development, maintain natural systems, and reduce risk. Increased engagement capacity also increases the alignment between sectors which in turn maximizes existing planning capacity and funding. Increased capacity can also result in better grant applications which provides more funding and facilitates the implementation of nature-based solutions which enhances natural systems and further reduces risk. These capacity-driven feedbacks with risk are represented in Figure 13, where the x-axis is planning capacity and the y-axis is risk. Low-capacity triggers actions that continuously increase risk and further decrease capacity, while higher capacity triggers positive actions that continuously reduce risk and increase capacity. Positive feedbacks highlight entry points for scaling up/maximizing adaptation efforts. Negative feedbacks highlight areas needing intervention, support and capacity building.

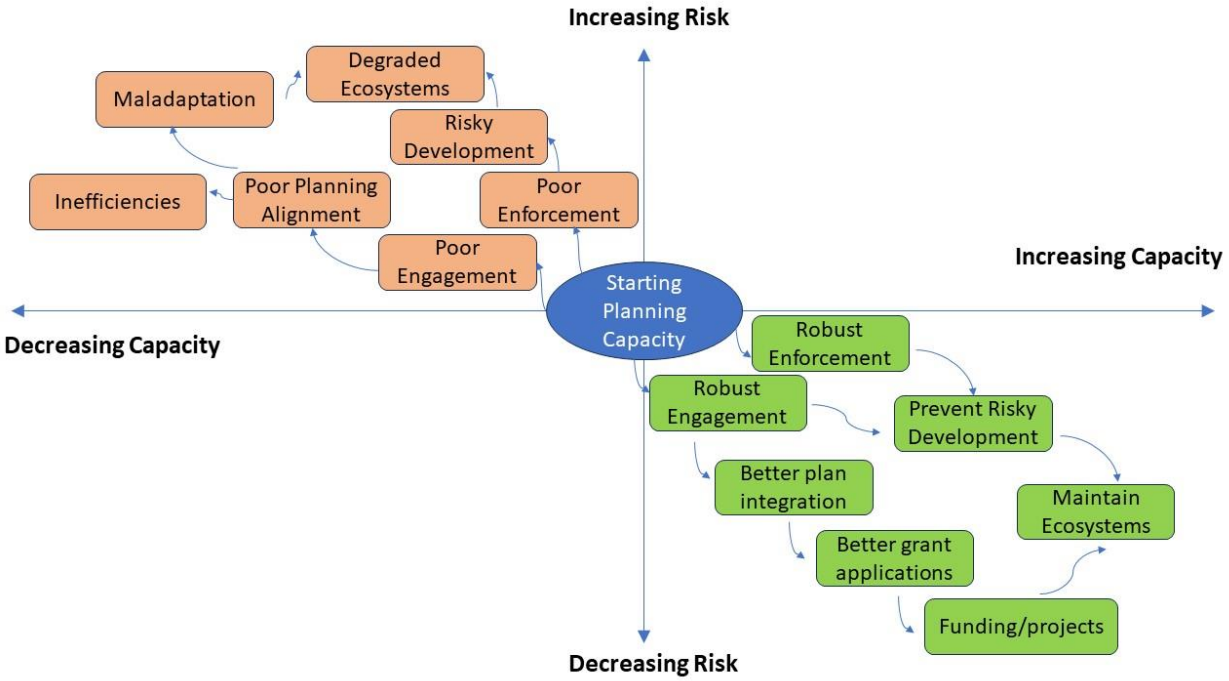

Figure 13. Positive and negative feedbacks between capacity and risk.

Considering the powerful influence of capacity; federal, state, and territorial governments should prioritize organizational capacity and allocate local funds proportionate to the urgency and potential magnitude of the crisis ahead. This equates to higher government salaries to overcome recruitment challenges, as well as larger teams to handle the ever-increasing workload of those managing development and hazards along the shoreline. This may seem unrealistic given the present demands on government agencies, be it health, education, infrastructure maintenance, etc. These competing priorities are noted by interviewees as challenges themselves and often seen as more urgent by citizens and decision makers. However, the positive feedbacks offered by increased staff capacity can pay dividends, perhaps even more so than investments in one-off projects. Although projects are also important, the positive feedback of capacity investments can potentially prove to be self-sustaining and provide larger returns.

This is not to discount the services provided by civil society or the private sector, as each play a key role in adaptation and can innovate and pivot in ways the government cannot. Future research may investigate how, in the absence of more internal capacity, the private sector can continue to support but close the current gaps in government-consultant planning transactions – regurgitating plans, lack of follow through after deliverables, understanding of local context, etc. This may benefit from examining other bodies of research such as public administration and corporate governance. Greater support for the non-profit sector may also help fill capacity gaps in government planning. Community organizations with ties to place are especially valuable for local resilience (Harangody et al., 2022), and augmenting their capabilities may provide similar feedbacks in resilience building. However, given the role that government planners play in managing development, protecting natural resources, and setting community priorities, an argument can be made that investments in public sector capacities should be prioritized.

F. Conclusion

This study examines the processes, challenges and context that are common across these island jurisdictions. Findings highlight the barriers islands face in gathering climate information, engaging stakeholders, aligning planning sectors, reducing vulnerability, implementing nature-based solutions, addressing uncertainty and learning from disasters. These challenges are largely driven by the lack of organizational capacity among coastal management and hazard mitigation programs, highlighting the need to increase staffing and expertise to successfully adapt to coming climate hazards. This study focuses on similarities across the islands; however, future work may benefit from a comparison between islands, as well as a comparison of the coastal and hazard governance structures and planning authorities that influence adaptation planning capacity and plan quality across the islands. The history of the island jurisdictions also warrants additional research on the effects of power dynamics between the federal government and territories and the legacies of colonialism on capacity. Island cultures also merit closer examination of the role that traditional knowledge (Lazrus, 2012; Mcleod et al., 2019) and culture (Adger et al., 2013) can play towards adaptation in these jurisdictions. This surprisingly did not come up

often in interviews, even when given the opportunity to highlight successes, best practices, or island context. This highlights that these particular fields are currently driven by western and federal perspectives. Lastly, island adaptation may benefit from additional research on the integration of the coastal management and hazard mitigation sectors given the common planning processes and challenges. Alignment between these and other sectors can help maximize government planning capacity and resources.

Although there are significant barriers to adaptation, there are numerous examples of the innovation and progress being made on the islands. This is driven by a collective acknowledgement of the need to act despite the challenges (*Excerpt 52*). Practitioners highlighted the interest and importance of sharing these innovative approaches and lessons learned within and across island regions. Shared experiences and struggles can not only build connections and capacity across islands (*Excerpt 53*), but the knowledge of these shared struggles can bring solace to practitioners and motivation to continue to care for and safeguard their island homes (*Excerpt 54*).

> *52) So working on climate issues here, I have found to be less contentious in many ways than how politically charged the issue has become in the mainland, because I think there is some general recognition that and people see the shoreline receding and they see that we've experienced these superstorms, these one in 100 year storms that we've seen every couple of years now. And I think that heightens people's sensitivity to and acceptance of the fact that climate change is real and something we should be taking action on.* ***(Coastal Manager)***
>
> *53) The other important factor that we have in common is that we are survivors, that we have the information and experience from firsthand…So it's easy to get the information and to start to learn, more than reading a book or journal or case study… So for us as survivors, we have a disadvantage, but this is the reality. So we have to take this as an opportunity.* ***(Hazard Mitigation Planner)***
>
> ***54)*** *And I just want to know and feel the confidence that I'm not alone on this dirt road that I'm traveling on by myself, as I progress. And knowing that other people are having those type of issues, gives me that [confidence].* ***(Hazard Mitigation Planner)***

CHAPTER 5. CONCLUSION: MOVING TOWARDS COASTAL ADAPTATION

Coastal communities face a daunting challenge as climate change impacts become more salient and substantial. Both human and natural systems along the coastline will face the brunt of these impacts. The foundations of integrated coastal management are intended to balance the needs of these systems, guiding development and uses along the shoreline for the benefit of human systems while protecting the natural. The success of this balancing act has been mixed, as evidenced by disappearing beaches and threatened homes. This predicament will only increase with rising sea levels and the rising risk of extreme storms. Adaptation to these impacts will require careful analysis and input from impacted stakeholders and will ultimately result in tradeoffs based on community priorities. Planning plays a key role in determining these tradeoffs and how adaptation is implemented along the shore. Through a plan evaluation and interviews, this research highlighted two planning mechanisms that can be leveraged for adaptation grounded in the fields of coastal management and hazard mitigation. The following section highlights opportunities to align these planning mechanisms to maximize adaptation potential.

A. Coastal Management and Hazard Mitigation Planning Alignment

1. Opportunities for Alignment

Although there is room for improvement, the study highlights the utility of coastal management plans and hazard mitigation plans to identify and achieve adaptation objectives. There are also opportunities to align these mechanisms to maximize island planning capacity and resources. Similarities between plans and their planning processes represent entry points for this alignment. From the planning guidance and structures of these plans, several similarities emerge:

- *both plans include an assessment of coastal hazard risk and capabilities,*
- *both plans identify strategies based on this assessment,*
- *both require public participation, and*
- *both plans are on 5-year cycles*.

Logical approaches for alignment may be to leverage the same datasets and/or risk assessments (ex: some CZMA 309 plans refer to the hazard mitigation plan risk assessment for coastal hazard information), maximize funding opportunities by identifying complementary strategies, and augment planning capacity and stakeholder input via joint engagement strategies (ex: leveraging the same advisory committee, or joint public meetings). Interviews with coastal managers and hazard mitigation planners highlighted a recognition of the importance of coordinating with their respective counterparts; however, coordination requires time and commitment to build connections across agency stakeholders. Although not necessary, these connections may be facilitated by aligning planning cycles in the jurisdiction. This within-state or territory coordination may require coordination across respective federal agencies overseeing these planning programs but would also help maximize federal funding and resources.

Identifying complementary strategies is an important alignment opportunity, especially for efforts to avoid maladaptation. Although distinct planning processes, coordination among planners will help to ensure that one plan's actions do not contradict another's in terms of the means to reduce hazard risk. Both plans and interviews underscored the connection between coastal management, hazard mitigation and adaptation, especially in terms of the adaptation potential of land use strategies. Although many hazard mitigation plans across the islands do not currently include land use strategies to reduce risk, hazard mitigation planners recognize the potential role of land use planning to mitigate hazards. Coastal management programs lead the land use planning and regulatory functions across most of the island jurisdictions, therefore coordination among hazard mitigation planners and coastal managers can fill current gaps in hazard mitigation plans with land use solutions.

2. Remaining Differences

These two plans are inherently different processes with different objectives. The similarities above may help bridge the gap between the two, but differences will remain due to the legislative requirements and criteria tied to the federal funding associated with these plans. In large part, these plans are funding mechanisms, and the funding requirements influence the development and structure of these plans. For example, approved hazard mitigation plans are a prerequisite for pre- and post-disaster assistance. This assistance is either based on disaster declarations or competitive programs, therefore funding is not guaranteed nor are funding levels known at the time of planning. This makes hazard mitigation plans somewhat opportunistic in that projects and potential funding sources are identified, but completion is dependent on funding availability. CZMA 309 funding is formula-based, therefore approximate funding levels for each state/territory coastal program are known. CZMA 309 Assessments & Strategies are specific to this funding source, so plans and strategies are developed based on what is achievable with available funding. Eligible activities under these funding programs also influence the content of the plans. Whereas disaster assistance can be used for a variety of mitigation activities including construction, 309 funding is meant for programmatic changes only and cannot be used for construction (those activities fall under Section 306 of the CZMA).

These differences are evident in some of the plan quality scores. Hazard mitigation plans scored significantly better with Integrated Planning, while CZMA 309 plans scored better with Nature-Based Adaptation. This makes sense since hazard mitigation planning guidelines require the integration of other sectors in the planning process (FEMA, 2015). Hazard mitigation planning is often a well-known process within government, as many jurisdictions have standing committees or forums made of agency representatives. In contrast, CZMA 309 planning is specific to the coastal zone management program, therefore not as well known or followed across other government agencies. Coastal programs are encouraged to engage government partners (NOAA, 2019), and many programs do, but processes are much less institutionalized across government. As to *Nature-Based Adaptation*, it is logical that the CZMA 309 Strategies score better as they are led by the coastal management program, a natural resource

agency, and based on legislation that explicitly aims to protect marine and coastal resources. Nature-based approaches can be achieved through programmatic changes eligible under 309 funding requirements, such as permitting programs, new shoreline regulations, and conservation policies. There were also significant differences within the Vulnerability Reduction, with 309 plans more likely to include *avoid* strategies and less likely to include *protect* and *accommodate* strategies than hazard mitigation plans. This could be attributed to the funding constraints of 309 funding.

B. Research Contribution

This work aimed to fill gaps in current adaptation planning research by highlighting the connection between fields that have previously been examined separately – coastal management, adaptation, planning – and doing so across island jurisdictions, areas that are seldom the subject of planning evaluation research. This work entailed three parts:

1. The development of an evaluation framework to assess coastal adaptation planning.
2. A quantitative plan evaluation of coastal management and hazard mitigation plans to assess the degree to which plans incorporate coastal adaptation principles.
3. A qualitative study of adaptation progress and challenges among U.S. Island jurisdictions based on interviews of practitioners.

A primary contribution of this research is the proposed *Coastal Adaptation Planning Evaluation Framework*. This work identified a set of guiding principles for coastal adaptation planning, drawing from the coastal management, adaptation, and planning literature. These principles include *adaptation intelligence, inclusive planning, integrated planning, vulnerability reduction, nature-based adaptation, and adaptive planning*. These principles, combined with plan evaluation methods, provide a structured and flexible framework to assess adaptation planning efforts across diverse settings and planning mechanisms. This research employed this framework to assess the effectiveness of current planning on islands, identify barriers to adaptation, and highlight best practices.

The other contribution of this research is the contribution to the body of knowledge regarding adaptation planning in coastal and island settings. The findings of the study highlight aspects of coastal management and hazard mitigation planning where adaptation principles can be better addressed, along with the challenges that islands face related to these principles. Many of the deficiencies and challenges identified can be traced to the general need for increased planning capacity across island jurisdictions.

C. Recommendations for Island and Federal Partners

The findings of the study inform a list of recommendations for island planners and, perhaps more importantly, the federal partners overseeing and supporting these planning programs. Recommendations are drawn primarily from the challenges and innovations identified in this work. The list below is not exhaustive and does not affirm that the following aren't already occurring, but it provides a preliminary

inventory of actions to consider and measure current efforts against. Future research may investigate the extent to which current programs and efforts accomplish these tasks and how they can be augmented.

Recommendations for Island Planners:

- Consider an expanded toolset within plans.
- Align strategies more closely with risk and capability assessments.
- Leverage existing planning processes to maximize engagement opportunities and staff capacity.
- Explore opportunities to leverage external partners and resources to fill capacity gaps, including academia, boundary organizations, federal technical assistance, and fellowships or internships.
- Make the case for capacity investments in state/territory budgets.
- Leverage interagency committees to facilitate alignment between sectors.
- Leverage comprehensive planning authorities and interagency committees to facilitate alignment among sectors.
- Assign staff dedicated to serve as the organization point person and liaison to other agency partners regarding adaptation and resilience issues to help with alignment.
- Plan for disaster recover pre-disaster to better take advantage of recovery opportunities.
- Engage with island partners for cross-island knowledge exchange.

Recommendations for Federal Partners:

- Provide guidance related to land use and nature-based solutions to mitigate hazards.
- Encourage alignment across federal programs.
- Support efforts to fill data gaps across islands, including through traditional ecological knowledge.
- Design and update federal programs to target highlighted challenges, especially capacity challenges.
    - Reconsider competition alternatives for island funding opportunities
    - Consider capacity in the review of competitive opportunities.
    - Increase technical assistance opportunities.
    - Adjust benefit-cost standards for areas with high costs, such as islands.
- Facilitate opportunities for cross-island knowledge exchange.

D. Island Adaptation through an Equity Lens

The findings of this study highlight the adaptation challenges facing island jurisdictions, such as frequent disasters, limited land, geographic isolation, high costs, and limited resources. This comes amid the often-disproportionate contributions to global greenhouse gas emissions and the impacts on islands (Lazrus, 2012). Planners across U.S. islands confront these challenges with limited staff capacity and bandwidth amid ever increasing operational demands. Competitive funding opportunities are often lost to higher capacity jurisdictions, further increasing capacity gaps between islands and some of their continental counterparts. Considering these obstacles, an argument can be made that island adaptation should be considered through an equity lens, especially with respect to the federal support given to them. Others have highlighted the equity and justice implications of climate change for SIDS internationally (Adelman, 2016; Klepp & Herbeck, 2016; Lazrus, 2012; Zellentin, 2015). This research highlights this implication for U.S. islands from the perspective of capacity and the distribution of federal adaptation resources. Recent federal initiatives, such as the current administration's Justice 40 Initiative, aim for more equitable federal resource distribution to address environmental justice and disadvantaged communities (The White House, n.d.). This research highlights the need to consider islands within these equitable funding frameworks and develop metrics that capture the capacity gaps driving inequities in funding allocation. Despite the challenges, the innovations and progress identified across the islands highlight the benefit that added investment can make to facilitate adaptation on islands. Indeed, islands are inherently adaptive and, if empowered, can adapt to the changes ahead (Betzold, 2015).

It is hoped that this work will drive discussions to improve planning both on islands and in other coastal settings. The findings and recommendations can inform conversations around the adaptation challenges on islands and ways to address these challenges, where planning mechanisms succeed or fail in facilitating adaptation, and the need for integrated coastal adaptation strategies. Other potential planning discussions informed by this work can include the consideration of land use policies to facilitate a managed retreat from hazardous areas, the preservation of valued natural resources, and the influence of and potential opportunities of disasters to facilitate adaptation on islands. Ultimately, it is hoped that this work is most beneficial to the practitioners that contributed to it, to the planners working daily to make their jurisdictions more resilient. Empowered with a bit more information gathered through this work, perhaps these island planners can continue to push their island homes towards adaptation.

APPENDIX A: PLAN EVALUATION SCORING PROTOCOL

General Scoring Protocol:

0 = Indicator is not included in plan

1 = Indicator is present but mentioned only briefly in text. No explanation, data, maps, or quantities are provided.

2 = Indicator is present and described in detail in text or conveyed through maps, quantitative data, or tables.

Note: *Indicators were identified based on subject matter expertise and similar studies* (Berke et al., 2012, 2014; Berke et al., 2018; Butler et al., 2016; Fu et al., 2017; Lyles, 2018; Meerow & Woodruff, 2020; Tang, 2008; Woodruff & Stults, 2016)

Table 14 - Plan Evaluation Scoring Protocol

Principle/ Category	Indicator	Description
Adaptation Intelligence *(Note: Indicators related to hazards refer to coastal-specific hazards related to climate change, not including earthquake, fire, or drought.)*		
Current Conditions	Coastline characteristics	Describes current coastline characteristics (e.g., miles of coastline, geology, landforms, etc.)
	Structures/Development trends	Provides an inventory of structures in the jurisdiction, and/or current development trends.
	Population trends	Describes current population trends
	Economic activity	Identifies and describes current economic activity in the coastal zone
	Beach conditions/shoreline change rates.	Describes current beach conditions (shoreline change, erosion/accretion)
	Wetland conditions	Describes current wetland conditions (acreage, trends, etc.)
	Reef conditions	Describes current reef conditions (health, coverage, etc.)
	Historical/current hazards	Identifies/lists the hazards that affect the jurisdiction
	Hazards prioritized	Hazards are ranked or prioritized in some way (e.g., risk, probability, etc.)
Future Conditions	Climate change data/projections	Describes or identifies regional/local climate change projections
	Climate change hazard	Considers climate change hazards (explicit consideration of climate change or SLR as a hazard)
	Coastal erosion	Considers coastal erosion as a hazard
	Sea level rise scenarios	Considers possible sea level rise scenarios
	Vulnerable structures/infrastructure	Identifies structures/infrastructure vulnerable to hazards (1 if general vulnerability is described, 2 if includes hazard exposure or impacts)
	Vulnerable population	Identifies vulnerable populations that are vulnerable to hazards (1 if general vulnerability is described, 2 if includes hazard exposure or impacts)
	Vulnerable ecosystems	Identifies and describes ecosystem vulnerability to climate change/hazards (1 if general vulnerability is described, 2 if includes hazard exposure or impacts)
	Vulnerable economic activities	Identifies vulnerable economic activities (1 if general vulnerability is described, 2 if includes hazard exposure or impacts)
	Vulnerable cultural assets	Identifies vulnerable cultural assets (1 if general vulnerability is described, 2 if includes hazard exposure or impacts)
	Vulnerability prioritized	Vulnerabilities are ranked or prioritized in some way. This may include ranking hazards based on vulnerability.
Capabilities	Data gaps	Identifies hazard and vulnerability data gaps and needs
	Capabilities/tools/policies	Describes existing capabilities/tools/policies/plans

Table 14 (Continued) – Plan Evaluation Scoring Protocol

Principle/ Category	Indicator	Description
Inclusive Planning		
Planning Process	Planning process	Describes process to develop the plan
	Stakeholders involved	Describes stakeholders involved in the process
	Public meetings	Describes use of public meetings
	Digital platforms	Describes use of digital platforms - website, social media
	Surveys	Describes use of surveys
	Plan comment period	Indicates the use of a plan comment period
	Advisory committee	Describes the role of an advisory committee as part of the planning process
Equity	Engage underserved	Involves underserved communities in planning process
	Vulnerability in underserved	Includes strategies to explicitly address vulnerability in underserved communities
	Community organizations	Community organizations are involved in planning process
Integrated Planning		
	Hazard mitigation plan	Refers to hazard mitigation plan (Do not score for HM plans)
	Coastal management plan	Refers to coastal management plan(s) or 309 Assessment & Strategy (Do not score for 309 Assessment & Strategy)
	Land use/comprehensive plan	Refers to land use or comprehensive plan
	Disaster recovery plan	Refers to disaster recovery plan
	Governance	Describes planning governance (i.e., authorities, structure, policies, plans) related to Hazard Mitigation, Land Use, CZM, Climate Change
	Land use planners	Land use planners are involved in planning process
	Coastal managers	Coastal managers are involved in planning process (Do not score for 309 Assessment & Strategy)
	Mitigation planners	Hazard mitigation planners/EM agency involved in planning process (Do not score for HM Plan)
	Plan alignment	Calls for plan alignment explicitly
	Interagency coordination	Includes strategies to improve interagency coordination

Table 14 (Continued) – Plan Evaluation Scoring Protocol

Principle/ Category	**Indicator**	**Description**
Vulnerability Reduction (*Note: Score 1 if indicator is listed or discussed in Capability Assessment (HMP) or Assessment (309), and 2 if included as a mitigation action (HMP) or strategy (309). Score 0 if not mentioned or if highlighted as an option/recommendation but not currently in plan or in practice.)*		
Avoid	Zoning	Describes the use of zoning to reduce hazard risk
	Permitting	Describes the use of permitting to reduce hazard risk - high hazard areas, special management areas
	Subdivision ordinance	Describes the use of subdivision ordinances to reduce hazard risk
	Shoreline setbacks	Describes existing or new shoreline setbacks to reduce hazard risk
	Transfer of development rights	Describes the transfer of development rights as a strategy to reduce risk
	Land acquisition	Describes the acquisition of land as a means to preserve open space to reduce risk
	Zoning overlays	Describes the use of zoning overlays related to hazards or climate change
	Density transfers	Describes the use of density bonuses or transfers to steer development away from hazardous areas
	Financial incentives/penalties	Describes financial incentives and/or penalties to encourage development away from hazardous areas
Retreat	Relocation	Relocating existing buildings/infrastructure
	Post-disaster down-zoning	Describes post-disaster zoning changes to reduce hazard risk
	Post-disaster relocation	Post-disaster relocation of structures/infrastructure
	Rolling easement	Describes the use of a rolling easement to discourage development within easement area (prohibits shoreline armoring)
	Repair/rebuilding restrictions	Describes restrictions for repair and rebuilding post-disaster
	Structural acquisition	Describes the acquisition of existing structures
Protect	Armoring	Describes the use of shoreline armoring to protect coastal infrastructure/property
	Flood protection	Describes flood protection structural solutions - levees, dams, bank stabilization/armoring
	Shoreline structures	Describes the use of shoreline stabilization structures - breakwaters/groins
Accommodate	Elevation	Describes elevating existing buildings to reduce flood risk
	Floodplain management	Describes the existence or establishment of a floodplain management ordinance that regulates development in the floodplain
	Floodproofing	Describes flood proofing strategies

Table 14 (Continued) – Plan Evaluation Scoring Protocol

Principle/ Category	**Indicator**	**Description**
	Stormwater infrastructure	Describes stormwater management system infrastructure enhancements
	Structural retrofit	Describes strategies to retrofit existing structures/infrastructure
	Building codes/design standards	Describes existing or new building codes/design requirements in hazardous areas
Planning, Information, and Capacity-Building	Decision-support tools	Describes the use or development of decision-support tools or the improvement of existing data for decision-making
	Research, studies, assessments	Describes or calls for new research, studies, assessments
	New plans	Describes or calls for new plans to address coastal climate impacts and vulnerability
	Special area management	Describes existence or use of special area management planning which includes consideration of hazards and/or climate change
	Community education	Describes strategies to educate the community on hazards, climate change, vulnerability
	Real estate disclosure	Describes the use or implementation of real estate hazard disclosure requirements
	Technical assistance/guidance	Describes strategies to provide technical assistance or provide guidance to constituents
	Staffing	Describes or calls for strategies to increase staffing to address hazards or climate change issues
	Flood mapping	Describes efforts to map flooding or other hazards
Nature-Based Adaptation *(Note: Score 1 if indicator is listed or discussed in Capability Assessment (HMP) or Assessment (309), and 2 if included as a mitigation action (HMP) or strategy (309). Score 0 if not mentioned or if highlighted as an option/recommendation but not currently in plan or in practice.)*		
Regulations	Conservation zoning	Describes the use of zones to preserve open space/ecosystems (e.g., protected areas, reserves, etc.)
	Dune protection	Describes existing or new regulations to protect dune areas
	Wetlands regulations	Describes existing or new regulations to protect wetland areas (e.g., buffer areas, permit requirements, etc.)
	Armoring restrictions	Describes restrictions on shoreline armoring (beach preservation)
	Environmental impact assessment	Requires the completion of an environmental impact assessment that includes consideration of hazards for new development

Table 14 (Continued) – Plan Evaluation Scoring Protocol

Principle/ Category	Indicator	Description
Actions	Nature-based solutions general	Calls for nature-based solutions to coastal climate hazards in general
	Coral reef restoration	Describes strategies to restore coral reefs
	Wetland restoration	Describes strategies to restore wetlands
	Beach/dune restoration	Describes strategies to nourish or restore beaches and/or dunes
	Living shorelines	Calls for a living shoreline project
	Green infrastructure	Describes strategies related to green infrastructure/low-impact development for stormwater management
	Planning / capacity building	Describes or calls for nature-based planning efforts, studies, capacity building efforts
Adaptive planning		
Monitoring/Eval	Plan monitoring / updating	Describes plan monitoring and updating processes
	Monitoring indicators	Describes monitoring indicators for plan tracking
	Previous plan	Reviews progress of previous plan
	Adaptation pathways	Includes adaptation pathways as a strategy (thresholds/criteria as triggers for alternative actions)
	Adaptive management	Mentions adaptive management
	Uncertainty	Acknowledges climate change uncertainty / sources
Implementation	Timetable	Identifies timetable for implementation
	Technical support	Identifies technical support needed to implement plan
	Adaptation/mitigation funding	Identifies adaptation or mitigation funding sources to implement plan
	Recovery funding	Identifies post-disaster recovery funding sources to implement actions
	Responsible agencies	Identifies responsible agencies to implement plan
	Actions prioritized	Strategies/actions are ranked or prioritized
	No-/Low-regrets strategies	Explicit mention of no-/low-regrets strategies (beneficial regardless of future condition)
	Scenario planning	Plan assesses risk and includes strategies for different hazard/climate scenarios
Goals and Objectives	Goals	Includes specific goals.
	Objectives	Includes measurable objectives.
	Adaptation	Plan makes direct connection to adaptation (as a need, goal, in strategies, etc.)
	Post-disaster recovery	Reference to mitigation/adaptation in post-disaster recovery

APPENDIX B: PLAN EVALUATION SCORES

Note: This table includes Percent Plan Coverage (max 100), Indicator Score (max 2), Principle Score (max 10), Total Plan Scores (max 60).

Table 15 - Plan Evaluation Scores

		Hazard Mitigation Plan Score						CZMA 309 Assessment & Strategy Score					
Indicator	**% of Plans**	**USVI HMP**	**Puerto Rico HMP**	**Am Samoa HMP**	**Hawaii HMP**	**CNMI HMP**	**Guam HMP**	**Guam 309**	**Hawaii 309**	**CNMI 309**	**Am Samoa 309**	**Puerto Rico 309**	**USVI 309**
Adaptation Intelligence													
Coastline characteristics	50.0	0	0	1	1	1	1	2	0	0	0	1	0
Structures/Development trends	100.0	2	1	2	2	2	2	1	1	1	1	2	2
Population trends	91.7	1	0	2	2	2	2	1	2	1	1	1	1
Economic activity	91.7	1	0	2	2	2	2	1	1	1	1	2	2
Beach conditions/shoreline change rates.	66.7	0	1	1	0	0	2	1	2	1	0	1	1
Wetland conditions	66.7	0	0	0	1	2	0	2	2	2	1	2	1
Reef conditions	83.3	0	0	1	2	1	1	2	2	1	1	2	2
Historical/current hazards	100.0	2	1	2	2	2	2	1	2	1	1	1	1
Hazards prioritized	83.3	1	0	2	2	2	0	1	2	2	2	2	2
Climate change data/projections	83.3	1	0	2	2	2	1	1	1	1	1	1	0
Climate change hazard	100.0	1	1	2	2	2	2	2	2	2	1	2	2
Coastal erosion	91.7	2	0	2	2	1	2	2	2	2	1	2	2
Sea level rise scenarios	66.7	0	0	1	2	2	1	2	2	1	0	1	0

Table 15 (Continued) - Plan Evaluation Scores

Vulnerable structures/infrastructure	83.3	2	1	2	2	1	1	2	1	1	0	1	0
Vulnerable population	66.7	2	1	1	2	2	1	2	0	0	0	1	0
Vulnerable ecosystems	100.0	1	1	1	2	2	1	2	1	2	2	2	2
Vulnerable economic activities	50.0	1	0	1	0	1	0	0	1	1	0	0	1
Vulnerable cultural assets	50.0	0	0	1	1	1	0	0	1	1	0	0	1
Vulnerable prioritized	50.0	2	0	1	1	0	0	1	1	2	0	0	0
Data gaps	100.0	2	1	1	1	2	2	2	2	2	1	2	2
Capabilities/tools/policies	100.0	2	2	2	2	1	1	2	2	2	1	2	2
	All	**USVI HMP**	**Puerto Rico HMP**	**Am Samoa HMP**	**Hawaii HMP**	**CNMI HMP**	**Guam HMP**	**Guam 309**	**Hawaii 309**	**CNMI 309**	**Am Samoa 309**	**Puerto Rico 309**	**USVI 309**
Adaptation Intelligence Score	**6.05**	**5.48**	**2.38**	**7.14**	**7.86**	**7.38**	**5.71**	**7.14**	**7.14**	**6.43**	**3.57**	**6.67**	**5.71**
Inclusive Planning													
Planning process	100.0	2	2	2	2	2	2	2	2	2	1	2	2
Stakeholders involved	91.7	2	2	1	2	2	2	2	2	1	0	1	1
Public meetings	41.7	1	1	0	1	0	1	0	2	0	0	0	0
Digital platforms	83.3	0	1	1	1	0	1	1	1	1	1	2	1
Surveys	75.0	0	1	1	0	1	0	1	1	2	2	2	1
Plan comment period	75.0	0	1	0	1	0	1	1	1	2	1	1	2
Advisory committee	50.0	1	2	1	2	0	1	0	2	0	0	0	0
Engage underserved	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Vulnerability in underserved	50.0	0	1	0	1	0	0	1	0	1	0	1	1
Community organizations	58.3	2	1	0	0	1	1	0	1	0	0	1	1

Table 15 (Continued) - Plan Evaluation Scores

	All	USVI HMP	Puerto Rico HMP	Am Samoa HMP	Hawaii HMP	CNMI HMP	Guam HMP	Guam 309	Hawaii 309	CNMI 309	Am Samoa 309	Puerto Rico 309	USVI 309
Inclusive Planning Score	**4.32**	**4.00**	**5.45**	**2.73**	**4.55**	**3.00**	**4.50**	**4.55**	**5.91**	**4.50**	**3.18**	**5.00**	**4.50**
Integrated Planning													
Hazard mitigation plan	50.0	2	2	2	2	2	2	2	2	1	2	2	2
Coastal management plan	50.0	1	1	2	2	1	1	2	2	2	2	2	2
Land use/comprehensive plan	91.7	1	2	1	2	1	2	2	0	1	1	2	2
Disaster recovery plan	41.7	1	1	0	2	0	0	0	0	1	0	0	1
Governance	83.3	2	2	2	2	2	2	1	1	0	0	2	1
Land use planners	100.0	1	2	2	1	1	1	1	1	1	1	1	1
Coastal managers	41.7	1	0	2	1	1	1	2	2	2	2	2	2
Mitigation planners	8.3	2	2	2	2	2	2	0	1	0	0	0	0
Plan alignment	58.3	2	2	0	1	0	1	2	1	0	0	0	1
Interagency coordination	83.3	0	1	1	2	1	0	2	2	2	2	2	1
	All	**USVI HMP**	**Puerto Rico HMP**	**Am Samoa HMP**	**Hawaii HMP**	**CNMI HMP**	**Guam HMP**	**Guam 309**	**Hawaii 309**	**CNMI 309**	**Am Samoa 309**	**Puerto Rico 309**	**USVI 309**
Integrated Planning Score	**6.25**	**7.22**	**7.78**	**7.22**	**7.78**	**5.56**	**6.67**	**6.11**	**5.00**	**4.44**	**4.44**	**6.11**	**6.67**
Vulnerability Reduction													
Zoning	50.0	1	1	0	1	0	1	0	0	0	1	0	1
Permitting	91.7	1	1	2	1	0	1	2	1	2	1	2	2
Subdivision ordinance	25.0	0	0	0	1	0	1	1	0	0	0	0	0
Shoreline setbacks	66.7	0	0	1	1	0	0	1	2	1	1	1	1

Table 15 (Continued) - Plan Evaluation Scores

Transfer of development rights	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Land acquisition	41.7	0	1	1	1	0	1	0	1	0	0	0	0
Zoning overlays	33.3	0	0	0	2	0	1	1	1	0	0	0	0
Density transfers	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Financial incentives/penalties	8.3	0	0	0	0	0	0	0	0	1	0	0	0
Relocation	58.3	1	1	1	2	1	2	1	0	0	0	0	0
Post-disaster down-zoning	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Post-disaster relocation	16.7	1	0	0	0	1	0	0	0	0	0	0	0
Rolling easement	8.3	0	0	0	1	0	0	0	0	0	0	0	0
Repair/rebuilding restrictions	58.3	1	0	0	1	0	0	0	1	1	1	1	1
Structural acquisition	33.3	1	0	0	1	0	0	0	1	0	0	1	0
Armoring	66.7	0	0	1	1	2	2	0	0	1	1	1	1
Flood protection	50.0	1	1	1	1	0	2	1	0	0	0	0	0
Shoreline structures	33.3	0	0	0	0	0	1	1	0	0	1	1	0
Elevation Butler)	25.0	1	0	0	1	0	1	0	0	0	0	0	0
Floodplain management	50.0	2	1	1	1	0	2	0	0	0	0	0	1
Floodproofing	16.7	1	0	1	0	0	0	0	0	0	0	0	0
Stormwater infrastructure (Butler)Butler)	41.7	1	0	1	2	0	2	2	0	0	0	0	0
Structural retrofit	50.0	2	1	1	1	2	2	0	0	0	0	0	0
Building codes/design standards	75.0	2	1	1	2	1	1	0	2	1	0	1	0
Decision-support tools	91.7	2	1	1	2	2	2	2	0	2	2	1	2
Research, studies, assessments	100.0	2	1	1	2	2	2	2	2	2	2	2	2
New plans	75.0	2	1	0	2	1	2	1	1	0	0	1	1
Special area management	58.3	1	1	0	0	0	0	2	1	1	1	1	0
Community education	91.7	2	1	1	2	1	0	2	1	1	2	1	2
Real estate disclosure	25.0	0	0	0	1	0	0	0	1	0	0	1	0

Table 15 (Continued) - Plan Evaluation Scores

Technical assistance/guidance	91.7	2	1	1	2	0	1	1	2	2	1	2	2
Staffing	58.3	1	1	0	2	0	2	0	0	1	1	1	0
Flood mapping	91.7	1	1	0	2	1	1	1	2	2	1	1	1
	All	**USVI HMP**	**Puerto Rico HMP**	**Am Samoa HMP**	**Hawaii HMP**	**CNMI HMP**	**Guam HMP**	**Guam 309**	**Hawaii 309**	**CNMI 309**	**Am Samoa 309**	**Puerto Rico 309**	**USVI 309**
Vulnerability Reduction Score	3.17	**4.39**	**2.42**	**2.42**	**5.45**	**2.12**	**4.55**	**3.18**	**2.88**	**2.73**	**2.42**	**2.88**	**2.58**
Nature-Based Adaptation													
Conservation zoning	75.0	0	1	1	0	1	1	2	2	1	1	1	0
Dune protection	25.0	0	0	0	1	0	0	0	1	0	0	1	0
Wetlands regulations	75.0	0	1	0	1	1	0	2	1	2	2	1	1
Armoring restrictions	41.7	0	0	0	1	0	0	0	2	1	1	1	0
Environmental impact assessment	41.7	1	1	0	0	0	0	1	0	1	0	0	1
Nature-based solutions general	66.7	2	0	0	1	0	0	1	1	1	2	2	1
Coral reef restoration	75.0	1	0	0	1	0	1	1	1	1	1	1	1
Wetland restoration	58.3	1	1	0	0	0	0	1	0	1	2	1	1
Beach/dune restoration (Butler)	33.3	0	0	0	1	0	1	0	1	0	0	1	0
Living shorelines	33.3	0	0	0	0	0	1	0	0	1	2	1	0
Green infrastructure	66.7	2	1	1	1	0	0	2	1	1	0	1	0
Planning / capacity building	91.7	2	0	1	1	1	1	2	1	2	2	2	1

Table 15 (Continued) - Plan Evaluation Scores

	All	USVI HMP	Puerto Rico HMP	Am Samoa HMP	Hawaii HMP	CNMI HMP	Guam HMP	Guam 309	Hawaii 309	CNMI 309	Am Samoa 309	Puerto Rico 309	USVI 309
Nature-Based Adaptation Score	**3.47**	**3.75**	**2.08**	**1.25**	**3.33**	**1.25**	**2.08**	**5.00**	**4.58**	**5.00**	**5.42**	**5.42**	**2.50**
Adaptive Planning													
Plan monitoring / updating	100.0	1	2	2	2	1	2	1	1	1	1	1	1
Monitoring indicators	41.7	0	2	0	1	0	1	0	0	1	1	0	0
Previous plan	83.3	1	1	1	2	0	1	2	2	2	1	2	0
Adaptation pathways	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Adaptive management	41.7	0	0	0	1	0	1	1	0	1	0	1	0
Uncertainty	75.0	1	1	0	2	1	1	1	0	0	1	1	1
Timetable	75.0	1	0	0	2	0	2	1	2	2	2	2	2
Technical support	66.7	1	0	0	1	0	0	1	1	2	2	2	2
Adaptation/mitigation funding	91.7	2	1	2	2	2	2	1	1	1	2	0	1
Recovery funding	58.3	2	1	2	2	2	2	0	0	0	0	1	0
Responsible agencies	100.0	1	2	1	2	1	2	1	1	2	1	1	1
Actions prioritized	100.0	2	1	1	2	2	1	1	1	1	1	1	1
No-/Low-regrets strategies	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario planning	25.0	0	0	0	2	2	0	1	0	0	0	0	0
Goals	100.0	2	2	1	2	2	2	1	2	2	1	1	1
Objectives	75.0	0	2	1	0	2	0	1	1	2	1	1	1
Adaptation	83.3	1	1	0	1	1	0	1	2	1	1	2	2
Post-disaster recovery	58.3	2	2	2	0	2	1	0	0	1	0	0	1

Table 15 (Continued) - Plan Evaluation Scores

	All	USVI HMP	Puerto Rico HMP	Am Samoa HMP	Hawaii HMP	CNMI HMP	Guam HMP	Guam 309	Hawaii 309	CNMI 309	Am Samoa 309	Puerto Rico 309	USVI 309
Adaptive Planning Score	**4.63**	**4.72**	**5.00**	**3.61**	**6.67**	**5.00**	**5.00**	**3.89**	**3.89**	**5.28**	**4.17**	**4.44**	**3.89**
Total Plan Score (max 60)		**28.0**	**24.2**	**23.4**	**36.0**	**23.1**	**26.8**	**30.0**	**29.4**	**27.7**	**22.5**	**30.0**	**24.8**

APPENDIX C: QUALITATIVE ANALYSIS CODE LIST

- **CONTEXT**
    - **Coastal Governance**
    - **Role/Organization**
        - Capacity-building role
        - Planning role
        - Regulatory role
        - Staff size
    - **Disasters**
        - Disaster Planning Challenges
        - Disaster Recovery
            - Adaptation in recovery
            - Pressure to recover quickly
    - **Climate Impacts**
    - **Funding**
        - 309 funding
        - FEMA funding
        - Funding Challenges
            - Planning Funding challenges
            - Adaptation funding challenge
            - Funding requirements
            - Competitive grants
            - Grant administration
    - **Island Context**
        - Culture
        - Geography/topography
        - Island similarities/challenges
        - Island/regional perspective
        - Jurisdictional issues
        - Recognition of climate risk
- **ADAPTATION**
    - **Adaptation Priorities**
        - Hazards
            - Erosion
            - Flooding

            - Sea Level Rise
        - Assets
            - Managing development
            - Natural resources
            - Physical infrastructure
    - **Adaptation Strategies**
        - Nature-based solutions
        - Land Acquisition, Retreat
        - Education, Communication
    - **Equity**
        - Strategies
        - Funding Equity
- **PLANNING**
    - **Plan alignment/Integrated Planning**
        - CZM-HM Coordination
        - Coordination with other agencies
        - Collaboration
        - Connection to other plans – land use, hazard mitigation, recovery
    - **Process**
        - Plan Development
            - Contractor
            - In-house
        - Planning Stakeholder engagement
        - 309 Process
        - HM Process
        - Incorporating Climate/Adaptation
- **CHALLENGES**
    - **Adaptation Challenges**
        - Politics
        - Adaptation Stakeholder Engagement
            - Public Perception
        - Capacity
            - Bandwidth
            - Expertise
            - Workforce development
        - Development Pressure
            - Limited Land

            - Enforcement
            - Tourism
        - Long-term planning perspective
    - **Planning challenges**
        - Alignment challenge
        - Planning engagement challenge
        - Data/information
        - Plan implementation
        - Planning timeline
        - Process challenge
        - Staffing/capacity
- **INNOVATIVE APPROACH**
    - **Coordination with non-profit**
    - **Leveraging technical assistance**
    - **Plan alignment**
    - **Process innovation**
    - **Project/effort**
    - **Sea level rise policy**
    - **Staffing innovation**
    - **Tools**

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