

*Review*

# Galveston Futures: Developing a disaster resilient community

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Accepted 13 October, 2019

**Galveston Futures is a cooperative venture, involving residents, architectural experts, urban planners and elected leaders, that strives to envision a resilient, sustainable and unified community on Galveston Island by encouraging civic participation in municipal planning. For Galveston's survival, it is essential to tie livability and resilience, especially to coastal disasters, into the concept of sustainability. This paper describes different projects that have been taken to accomplish the mission of the Galveston Futures.**

**Key words:** Natural hazards, disaster, risk, community resilience, sustainability, Galveston, Texas coast.

## INTRODUCTION

Galveston Futures is a cooperative venture between the Texas A & M University at Galveston and the Houston Advanced Research Center (HARC). The mission of this long-term project is - "To engage our community in visioning, designing and sustaining a livable and resilient Galveston Island through broad civic participation supported by state of the art technology."

Galveston Island is a barrier island located on the Upper Texas Coast in the United States about 50 miles southeast of Houston adjacent to the Gulf of Mexico (Figure 1). It is about 27 miles (43 km) long and about 3 miles (5 km) wide at its widest point. The island is oriented generally northeast-southwest, with the Gulf of Mexico on the east and south, West Bay on the west and Galveston Bay on the north. During the 19<sup>th</sup> century, Galveston became the major sea port and commercial center in the U.S. But after the deadliest hurricane in 1900, the port of Houston was developed and as a result Galveston lost its previous national levels of importance.

Galveston Futures envisions an Island where green spaces, both natural and urban, enhance rather than merely coexist with the built environment. Wide beaches

and multiple dune lines will not only provide recreational opportunities but serve as a welcomed first defense against hurricanes and tropical storms. Restricting building in hazardous areas will prevent loss of property and life, protect sensitive ecosystems and preserve beautiful vistas.

Galveston Futures is founded on the belief of sustainable development, which as defined by the 1987 United Nations Brundtland Report, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It looks at the need to achieve a balance between use and conservation both now and in the future. Galveston Futures suggests that the concepts of livability and resilience will present pathways to more sustainable futures. In order to do this, it is critical to involve the community in every step of sustainability planning. Further it is essential to tie livability and resilience - especially to coastal disasters - into the sustainability concept. This paper presents a summary of various ongoing activities that are taken to accomplish the mission of the Galveston Futures.

## CONCEPT OF RESILIENCE TO NATURAL HAZARDS

There are many different definitions of resilience. In Latin, the word 'resilio' means 'to jump back'. In a mechanical

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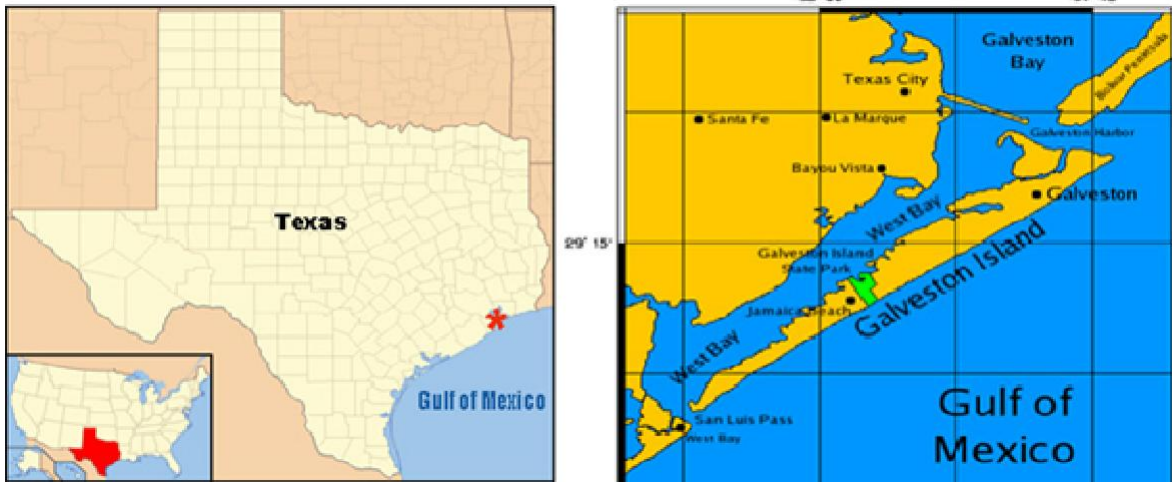


Figure 1. Location of Galveston Island. (Source: [http://en.wikipedia.org/wiki/Galveston\\_Island](http://en.wikipedia.org/wiki/Galveston_Island)).

sense, the resilience of a material is the quality of being able to store strain energy and deflect elastically under a load without breaking or being deformed (Gordon, 1978). The Oxford English Dictionary (1989) defines resilience as: (i) the act of rebounding or springing back and (ii) elasticity. Since the 1970s the concept has also been used in a more metaphorical sense to describe systems that undergo stress and have the ability to recover and return to their original state (Klein et al., 2003).

Resilience is seen as a desirable property of natural and human systems, including cities and coastal zones, in the face of a range of potential stresses, including weather-related hazards (UN/ISDR, 2002). In terms of natural hazards, it is defined as the coping capacity and ability to recover quickly from adverse impacts of hazards (McEntire, 2001). Thus, resilience is often used to define the vulnerability to natural hazards along with the term 'resistance' to describe the coping capacity. Clark et al. (1998) defines vulnerability as a function of two attributes: 1) exposure (the risk of experiencing a hazardous event) and 2) coping ability, subdivided into resistance (the ability to absorb impacts and continue functioning) and resilience (the ability to recover from losses after an impact).

The capacity of resilience is not the same for all places or cities. For instance, Galveston was completely destroyed by the deadly '1900 hurricane'. It was the deadliest hurricane in the United States history that killed about 8 thousand people (Bixel and Turner, 2000). In recent times, Hurricane Alicia and Hurricane Ike devastated the Island with strong wind and storm surge in 1983 and in 2008. But Galveston recovered very well from these disasters and today it is still a vibrant community. On the other hand, Indianola used to be a major Texas port located on the Matagorda Bay. It was wiped out by a devastating hurricane in 1886 and was never able to recover at all. Today, Indianola is just an abandoned town

in Texas (Handbook of Texas, 2007).

Although resilience can be defined in terms of natural hazards, the challenge remains to transform the concept into an operational tool for policy and management purposes: a challenge that thirty years of academic debate does not seem to have resolved (Klein et al., 2003).

## ELEMENTS OF A RESILIENT COMMUNITY

The community development theory has demonstrated that success and sustainability of a community depend on its ability to appreciate, access and utilize the major forms of capital (Beeton, 2006). The literature suggests that the notion of capital is very much related with the concept of disaster resilience (Mileti, 1999; Tobin 1999). There are five major forms of capital that a community can utilize in building resilience. These include; natural, physical, economic, human and social capital (Figure 2).

The following is the discussion of the major forms of capital with respect to the Galveston Island and surrounding region.

### Natural capital

Natural capital refers to the natural resources and environmental assets that a community possesses. Galveston Bay is the largest and most biologically productive estuary in Texas consists of four sub-bays - Galveston, Trinity, East and West Bays. The bay provides nursery and spawning grounds for large amounts of marine life and is important for both commercial and recreational fishing. Its ecosystem is composed of a complex set of overlapping habitats include uplands, wetlands, oyster reefs, open-Bay (water/bottom), sea grass meadows and inter-tidal mud flats (GBEP, 2007).



**Figure 2.** Elements of a resilient community.

### **Physical capital**

Physical capital refers to the built environment, which comprises of residential housing, public buildings, dams and levees and shelters. It also includes lifelines such as electricity, water, telephone and critical facilities such as hospitals, schools, fire and police stations and nursing homes (Mayunga, 2007). The greater Houston area is one of the most urbanized and industrialized areas in the world. Houston is the largest city in the State of Texas and the 4th largest city in the United States. A lot of new developments are going on in and around the Galveston Bay region. More than \$2.7 billion in construction is currently underway on the Galveston Island. Although physical capital is one of the most important resources in building community resilience to cope with disasters, building physical capital can reduce the natural capital through loss of vegetation and wetlands.

### **Economic capital**

Economic capital denotes financial resources that people use to achieve their livelihoods. It includes savings, income, investments and credits. Economic capital is very important in building disaster resilience as it increases the ability and capacity of individuals, groups and communities to absorb disaster impacts and speed up the recovery process (Mayunga, 2007).

Houston was built largely on the oil, natural gas and related chemical industries in this region. Port of Houston is the largest port in the U.S., based on foreign tonnage and the 2nd largest in domestic tonnage. It is the 6th largest port in the world. The Houston MSA's Gross Area Product (GAP) in 2006 was \$336.8 billion; only 21 nations other than the United States have a GDP exceeding Houston's GAP (Houston Area Profile, 2007).

### **Human capital**

In general terms, human capital refers to the stock of skills and knowledge gained by a worker through education and experience that increases the ability to perform labor so as to produce economic value (Sullivan and Sheffrin, 2003). In terms of community resilience, it can be associated with education, health, skills, knowledge or information which a community acquires through education, training and experience that increases their understanding or perception of community risks and increases the ability to develop and implement risk reduction strategies. Galveston is home to three post-secondary institutions serving the region including the University of Texas Medical Branch, Texas A & M University at Galveston and Galveston College. The University of Texas Medical Branch is the oldest and one of the largest medical schools in Texas with health care complex,



**Figure 3.** Design Charrette at Galveston.

education and research facilities.

### **Social capital**

Social capital is defined as the features of social organizations such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit (Putnam, 1995). Cities, counties, state and federal governments have emergency management programs to help people during disasters. City of Galveston has also begun recovery planning. Medical Centers and volunteer organizations e.g. Red Cross, Salvation Army, etc. would be helpful for citizens during a disaster. Neighbors often help during a disaster. Study shows that social capital resources (networks of strong and weak ties) are useful to improve a community's resilience to risks and hazards (Murphy, 2007). In this project, civic participation through which community groups and stakeholders are brought together to designing a sustainable community is a prime example of utilizing social capital.

### **APPROACH AND DISCUSSION**

We explore a place-based approach, which is Galveston in this study. A place-based approach promotes a framework that allows stakeholders to both develop shared meanings on place and establish priorities for action that can help guide public policy (Nilsen, 2005). A place-based approach is appropriate because local governments share primary responsibilities for disaster management. Private coastal development is largely determined by local regulations, infrastructure, demand, risk and time value of capital. Moreover, a place-based

approach can provide the opportunity to identify patterns of community resilience and response strategies that are ideal for selected coastal sites.

Using the place-based approach, 'Galveston Futures' is an attempt to engage civic participation in their own community planning and to improve different forms of capital for making the community more resilient. The activities or projects that have been taken so far include:

- i) Defining and measuring resilience using civic participation through design charrette and keypad voting that have increased community perception or understanding of risks. (An example of improving both social capital e.g. ties from civic participation and human capital e.g. increase of understanding or perception of community risks).
- ii) Using Galveston as a "test bed" or technique development that can be applied to other similar coastal areas that is, developing Community Resilience Indicators (CRIs), coastal communities planning atlas and East Lagoon nature park improving human, social and natural capitals.
- iii) To provide better idea of risks and vulnerabilities of the region especially on hurricanes and coastal erosion so that all forms of capital can be improved utilizing this information.

The current activities and projects that serve the mission of Galveston Futures towards developing a resilient community are described below:

### **Defining and measuring resilience using civic participation**

#### ***Design charrette***

In conjunction with the Houston Advanced Research Center (HARC), the Center for Texas Beaches and Shores (CTBS) participated in a planning session in June, 2006 in which a broad section of Galveston residents, architectural experts and professional urban planners collaborated to design a park for the east end of Galveston Island (Figure 3).

Cutting edge keypad polling technology allowed participants to answer questions about how the area is currently utilized and amenities that would make the area more appealing to the public. The results of each poll would appear within seconds on one of two large screens. The participants worked in six small groups with designated facilitators to assemble a priority list for the park design incorporating their areas of highest concern, such as ecological protection, use of current facilities, further development, maintenance and funding.

Additional polling exercises assisted participants in further defining high priority concerns for the area. Each group drew their designs on large maps, using stickers with predetermined symbols to identify key elements and



**Figure 4.** Aerial view of the East Lagoon Nature Park.

markers to define roads and trails.

#### ***Keypad voting at the state of the bay symposium***

The CTBS conducted an interactive presentation in January, 2007 at the 8<sup>th</sup> Biennial State of the Bay Symposium held at Galveston with the audience keypad voting and the audience responses were shown instantly on large screen. The polling questions were designed in a way so that people could define community resilience with respect to Galveston. A good number of audience participated in the keypad voting and the purpose was fully served.

#### **Using Galveston as a “test bed”/technique development.**

#### ***Developing community resilience indicator-CRI Galveston workshop***

Invited by the Coastal Services Center (CSC) of the National Oceanic and Atmospheric Administration (NOAA), Texas A & M University (TAMU), Texas A & M University at Galveston (TAMUG) and the Houston Advanced Research Center (HARC) submitted a proposal to develop a suite of Community Resilience Indicator (CRIs) and a comprehensive strategy for gaining community support and input into CRI development and a strategic plan for future training in the use of CRIs to enhance coastal community resilience along the Gulf coast. The project has recently been funded and already underway.

A CRI workshop will be held in Galveston which will

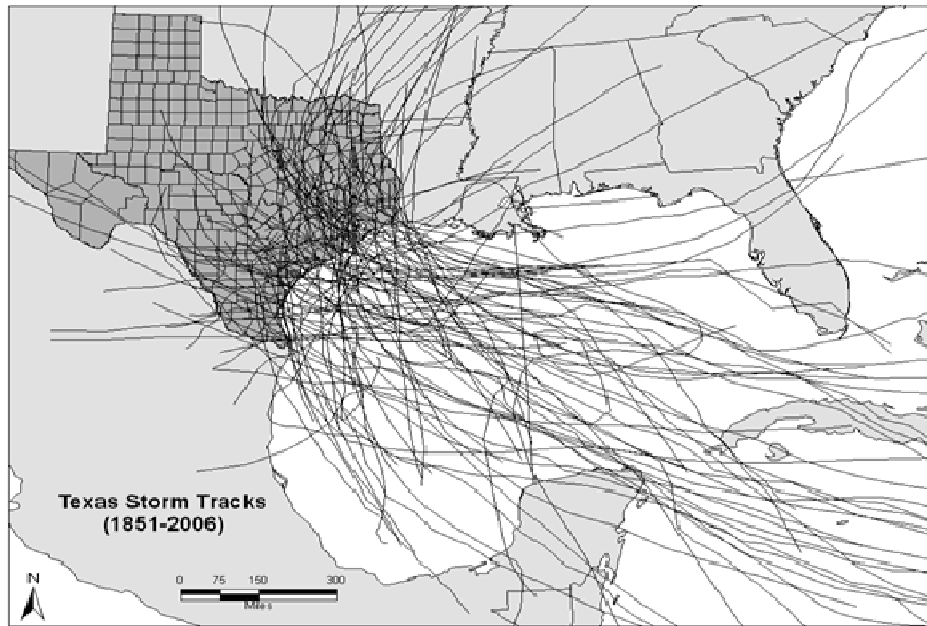
bring together citizens, decision makers and planners from Galveston and members of the Texas Coastal planning and management community. This workshop will discuss the Community Resilience (CR) approach, present examples of CRIs, explore potential uses with the goal of soliciting feedback on acceptance, understanding and needed modifications.

#### ***Coastal communities planning atlas***

The Center for Texas Beaches and Shores (CTBS) at Texas A & M University- Galveston and the Department of Landscape Architecture and Urban Planning (LAUP) at Texas A & M University has developed an educational tool for decision makers and local residents for Texas. This tool, the Coastal Communities Planning Atlas, is implemented via ArcGIS Server and provides web based access to a variety of datasets important for coastal community planning.

#### ***East Lagoon Nature Park***

The goal of the East Lagoon Nature Park (Figure 4) project was to design a park protecting sensitive habitats, wetland and lagoon areas while best utilizing the economic potential of the land. Over a semester, students of the Marine Resource Management program under the supervision of a professor incorporated, with minimum impact to the 800+ acre park, locations for restaurants, kayak rentals, bird-watching stations, hike and bike trails and an interpretive nature center.



**Figure 5.** Historical storm tracks of Texas from 1851 to 2006.

## **Better idea of threats and vulnerabilities**

### ***Texas hurricanes project***

A research project was recently completed on Texas and the Gulf of Mexico hurricanes. A total of 104 tropical storms and hurricanes affected the Texas coast between 1851 and 2006 (Islam et al., 2009). The visualization of tracks from the 104 storms that made landfall in or very near Texas from 1851 through 2006 are presented in Figure 5.

Of these storms, 66 were classified as hurricanes and 24 became major hurricanes (category 3 or higher). One of the most interesting findings of this research is that about half (54%) of all the Texas storms (56 out of 104) formed in the Gulf of Mexico. Also, more than half (56%) of the storms making landfall in Texas hit the Upper Coast with a concentration around the Galveston Bay region. Of these Upper Coast storms, most of them (66%) formed in the Gulf of Mexico. This is in sharp contrast to Louisiana and the Lower Coast of Texas. During this period, 39 storms hit the Lower Texas Coast of which only 13 (33.33%) storms formed in the Gulf and only 39% of the total storms hitting Louisiana formed in the Gulf of Mexico. The monthly distribution of all tropical storms and major hurricanes hitting Texas shows a peak in August and September. However, Gulf-originated storms and major hurricanes often form early in the hurricane season and actually peak in June.

The CTBS reconstructed historic hurricane scenarios that formed and made landfall rapidly on the Texas coastline and suggested that these storms are especially

challenging for emergency planners, citizens and public officials. In the next step, the CTBS will develop response strategies against these fast moving Texas hurricanes that might affect Galveston.

### ***Texas coastal erosion data network***

Texas A & M University at Galveston hosts a website for the Texas Coastal Erosion Data Network (TCEDN). This site is an evolving compendium of projects along the Texas coasts that deal with coastal erosion. The overall goal of the TCEDN is to provide a clearinghouse and data repository for data on coastal natural hazards and resources, specifically related to coastal erosion. The goal is to provide and make accessible, a comprehensive repository of historical and up-to-date data related to coastal erosion as well as sand and beach resources. The site has been managed by the CTBS since 2006. The link of TCEDN is <http://coastal.tamug.edu>.

## **Conclusion**

In this paper, we describe different projects that are being completed to serve the mission of the 'Galveston Futures' towards developing a disaster resilient community on the Galveston Island. A resilient community is comprised of five forms of capital. Using a place-based approach we show that these projects are linked with different forms of capital and improving the resources, thus, helping to develop a disaster resilient community that can be a

model for other coastal communities.

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