Chapter 15
Waves of Adversity, Layers of Resilience: Floods, Hurricanes, Oil Spills and Climate Change in the Mississippi Delta

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Abstract The Mississippi delta is a place of remarkable ecological, cultural and economic significance. Prevailing practices are, however, unsustainable; and climate change compounds disaster risk in the region. Delta communities need to build layers of resilience as a buffer against the waves of adversity they face. The historical context and distinctive social-ecological systems of this region are described and the relationship between resource use, disaster risk and resilience explored, with a focus on Hurricane Katrina and the BP-Deepwater Horizon oil spill. This exploration highlights four delta imperatives: (i) stem wetland loss and restore delta ecosystems to sustain coastal livelihoods and reduce disaster risk in the face of climate change; (ii) confront the 'safe development paradox'; (iii) address the drivers and root causes of social vulnerability that predispose marginalised groups and communities to disaster; and (iv) reframe governance thinking and practices that lead to environmental degradation and compound disaster risk. Barriers and opportunities are then discussed with respect to the human, physical, economic, social and natural capital needed to construct layers of resilience. A process of deliberative delta governance is recommended to foster community resilience, adaptive capacity and sustainability. Three priority actions are highlighted to translate this recommendation into practical reality: (i) articulate, share and celebrate delta narratives about overcoming adversity and building resilience; (ii) design and institutionalise inclusive processes of community disaster risk reduction and resilience planning; and (iii) sustain region-wide strategic collaborative planning processes to address the intractability of climate change that delta communities cannot resolve alone.

Keywords Mississippi delta · Katrina · BP oil spill · Climate change adaptation · Governance

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15.1 Introduction

The Mississippi delta is an iconic location of immense strategic, ecological, economic and cultural value. It is a region that has experienced floods, hurricanes and technological disasters. It is a global hotspot for climate change impacts. Vast areas of the deltaic plain will be under water in coming decades because the rate of sea-level rise is much faster than the rate at which the slowly subsiding deltaic plain is being built up. To compound matters, many delta communities are poor and socially vulnerable. Communities living in this low-lying region need to build layers of resilience as a buffer against waves of adversity that will get progressively worse in the face of climate change. This chapter provides an overview of recent delta history, the distinctive social-ecological systems of this region and describes recent disaster experience, with a focus on Hurricane Katrina and the BP-Deepwater Horizon (BP-DWH) oil spill. It identifies lessons learned, explores opportunities and challenges for building resilience and suggests priority actions for adapting to climate change.

15.2 Life in the Mississippi Delta: Abundant Natural Resources, Disaster Risk and Resilience

The Mississippi delta is a cornucopia of natural resources that has attracted people for millennia. The river drains over 40 % of the lower 48 states of the United States (US) and discharges into the Gulf of Mexico via an ecosystem complex of incredible diversity, productivity and value. The delta is home to over 2.2 million people who have contributed manifold cultural riches to the nation, including distinctive Cajun and Creole cultures, cuisine, music and literature. The delta plays a pivotal role in the regional and national economy through, among other things, navigation and shipping, oil and gas, a range of petrochemical and other industries as well as fisheries, forestry, agriculture and flood protection, water supply, tourism and recreation. Delta ecosystems generate annual benefits in the order of US$ 13–47 billion and the minimum asset value of these ecosystems would be US$ 330 billion—1.3 trillion (at 3.5 % discount rate) if this natural capital were treated as an economic asset (Batker et al. 2010) (Fig. 15.1).

For over a century, the delta has been exploited as if it can provide a limitless supply of natural resources (Saikku 2005; Morris 2012). Resource over-exploitation and transformation of the lower reaches of the Mississippi river and surrounding wetlands now jeopardise the ability of the delta to sustain the provision of cherished ecosystem goods and services. About 4,870 km^2 of wetlands have been converted to open water since the 1930s and a further 4,530 km^2 could be lost over the next 50 years (Boesch et al. 1994; NRC 2006; LACPRA 2012). Barrier islands have shrunk and the coastline has retreated by nearly 50 km in places. Many of those exposed to floods, coastal storms or oil spills have limited access to the resources necessary

Fig. 15.1 Wetlands of the Mississippi delta. (Source: photograph by Bruce Glavovic)

to cope with sudden shock events let alone the prospect of rising sea-level. Delta communities and those whose livelihoods depend on these ecosystems face escalating disaster risk; a prospect that is compounded by climate change. How did this predicament come to pass? What are the prospects for the future? And what can be learned from recent disasters to chart pathways towards resilience and sustainability? The next section provides a brief historical overview of the delta, with a focus on New Orleans, to highlight the intricate and complex interconnections between patterns of resource use, disaster risk, resilience and sustainability.

15.2.1 Waves of Adversity

Delta communities face an array of hazards. Early settlers had to learn to live in this watery milieu and cope with regular riverine flooding. In more recent times, and especially since the mid-twentieth century, extensive protection works have been constructed to control flooding and facilitate physical development in the delta and New Orleans in particular (Colten 2000). Major floods were experienced in 1927, 1937 and 1973. Flooding was averted as recently as 2011 when spillways were

opened to alleviate high flow rates past New Orleans. Between the 1850s and late 2000s, Louisiana was struck by 54 hurricanes and 52 tropical storms. Hurricanes have caused serious flooding in New Orleans no fewer than 38 times. Those living in the delta also face a host of technological hazards. The river between Baton Rouge and New Orleans is lined with more than 130 petrochemical plants and many other industries that together have led some to describe the area as 'Cancer Alley' (Allen 2003) or the 'Chemical Corridor' (Lerner 2005). In 2010, the BP-DWH oil spill caused the worst environmental disaster in US history. To compound matters, the combined impact of sea-level rise and deltaic subsidence are likely to result, conservatively, in the submergence by 2100 of all terrain less than one m above current sea level (Blum and Roberts 2009). Delta prospects are dismal because "significant drowning is inevitable" (Blum and Roberts 2012, p. 655). Understanding the nature of this constellation of risk and what can be done to reduce it needs to be located in the context of historic patterns of resource use, and the vulnerability and resilience of the social-ecological systems of the delta.

The deltaic plain has been extending seawards since the relative stabilisation of sea level about 6,000–7,000 years ago (Day et al. 2007). It has alternated between cycles of land loss followed by gain with the creation and retraction of deltaic lobes every 500–1,500 years (Törnqvist et al. 1996); forming six distinct lobes where the river has discharged into the Gulf as it meandered across the plain. Over time, the delta, comprising wetlands and marshes that trap sediments and form peaty soils, as well as distributaries, barrier islands and ridgelines, encompassed an area of about 25,000 km^2. The health and productivity of these ecosystems are dependent on the flow of river water and sediments to build up the land and 'feed' the delta. The flow patterns of the river including periodic pulses of floodwaters together with coastal storms have created a distinctive disturbance regime that sustains delta ecosystems and underpins their profound productivity and abundance of coastal and marine life, migratory birds and wildlife.

Human settlement in such a dynamic and high risk environment poses a significant challenge. Archaeological evidence shows occupation dating back 12,000 years. Early occupants and more recent Native Americans, including Natchez, Choctaw and Chickasaw tribes, thrived in the delta and used a range of strategies to cope with floods and storms, including making their camps on high ground, building substantial earthen mounds and migrating to and from the region on a seasonal basis. From the mid-1500s, the region was explored by the Spanish and then successive waves of settlers, including French from the seventeenth century, and more recently Arab, African, German, English, Irish, Scots-Irish, Jewish, Italian, Chinese, Mexican and southeast Asian peoples. European settlement was characterised by conflict, slavery and white colonial rule (Cobb 1992; Woods 1998). In the twentieth century, the region gained ill-repute for political wrangling and corruption, racial discrimination and waxing and waning economic fortunes (Parent 2004)—a fraught history that shapes contemporary disaster risk.

European settlers faced waves of adversity, including wars, pestilence like cholera, typhoid and yellow fever; extremes in temperature, humidity and rainfall; storms, and riverine and coastal flooding. New Orleans was founded by French

settlers in 1718 on high ground on the banks of the Mississippi River near the present day French Quarter. It took more than 200 years "to wrest the city from nature" (Colten 2006a). By 1840, New Orleans was the third largest city in the US, with over 102,000 people, indicating its strategic import at that time. Through the course of the nineteenth century, backwater flooding from the river was more of a threat than Gulf storms because the wetlands acted as a protective barrier. By 1930, the New Orleans population had reached over 458,000 and it reached a peak of over 627,500 in 1960. Two main driving forces facilitated the growth of New Orleans in the twentieth century: the drainage of low-lying swampland and the construction of flood protection works. In 1893, city officials set out to drain the swamplands east of the river to stimulate economic development and improve public health prospects. The innovative Wood Screw Pump was designed by New Orleans native A.B. Wood in 1913 and installed soon thereafter to drain the swamps. The second major factor was the construction of an elaborate flood protection system, including levees, spillways and flood protection barriers. Extensive improvements to the levee system were stimulated by the 1927 Mississippi River flood—the most catastrophic river flood in US history (Barry 1997). As the floodwaters headed towards New Orleans, the distraught city elite successfully lobbied state and federal officials to breach levees downstream from the city so that levees protecting the city would not be compromised. The levees at Caernarvon were dynamited causing devastating flooding in St. Bernard and Plaquemines parishes. This self-serving action by the New Orleans elite lingers in the region's social memory prompting some to think that the Katrina levee failure was a deliberate act to protect elite interests (Dyson 2006; Lindahl 2012). In 1928, flood protection was declared a federal responsibility and the US Army Corps of Engineers (USACE) was designated responsible for flood protection works. Levee construction under federal direction ensued; as did other works such as spillways and barriers that effectively brought the river under control. The lower Mississippi River became an engineered system no longer prone to periodic shifts from one lobe to another. The incessant flooding and 'unsanitary conditions' of the previous century became a thing of the past.

Hurricanes have repeatedly devastated the region and stimulated federally supported flood protection works. In 1947 and again in 1965, hurricane-induced flood losses prompted the federal government to intensify investment in extensive protective works that, among other things, facilitated expansion of suburban development into low-lying swamplands east of downtown New Orleans. Hurricane Betsy ravaged communities in the region in 1965 when storm surges overtopped the levee system east of New Orleans and inundated St. Bernard Parish and large areas of Orleans Parish. Betsy killed 74 people and caused over US$ 1 billion in property damage in the state. The US Congress quickly passed flood protection legislation and soon remnant wetlands east of the city were being barricaded by levees. In 1968, Congress passed the National Flood Insurance Act to provide insurance against flood damage. In 1969, Hurricane Camille caused widespread damage in the region, killing 256 people. But with improved flood protection and insurance underpinned by the federal government, suburban development expanded rapidly into former low-lying swampland that began subsiding as peaty soils dried out. In

the early twentieth century, nearly all city neighbourhoods and residents lived above sea level. By the late 1960s, up to half of the city's population lived below sea level as New Orleanians flocked to the new suburbs (Campanella 2006).

The Mississippi River has long been a major transport artery and trade route, with New Orleans being a strategic location from its inception. Harnessing this potential was a major driver for engineering interventions to control the river. The Port of New Orleans and Port of Southern Louisiana together now constitute one of the largest and busiest port systems in the world. Major works were undertaken in the first half of twentieth century to create an inner harbour Port complex. Federal funds were secured to connect these inner harbour facilities more directly to the Gulf of Mexico via a 122 km shipping canal called the Mississippi River Gulf Outlet (MRGO). Despite warnings of severe environmental, economic and societal impacts, construction of MRGO was approved and completed in 1965. The promises of economic boon were never realised; erosion of the marshes lining MRGO was rampant—up to 5 m per annum; usage by ocean-going traffic declined sharply despite significant annual maintenance costs; and, to compound matters, it was judged by experts to act as a funnel that amplified storm surges and played a key role in catastrophic levee failure when Hurricane Katrina struck in 2005 (Freudenburg et al. 2008; Shaffer et al. 2009).

Channelizing and leveeing of the river together with damming and flood control works have caused a drop of up to 50 % in sediment loads previously transported by the river (Blum and Roberts 2009). Water flow has been reduced and sediments are deposited in Gulf waters rather than building up the subsiding delta. To compound matters, from the 1930s onwards, oil and gas exploration and production intensified in the marshes and extended out into the Gulf, peaking in the 1960s through to the 1980s. Even in the absence of a major spill, oil and gas activities have had significant negative ecological impacts (Ko and Day 2004). The delta is now a labyrinth of navigation channels and pipelines that enable seawater to penetrate salt-intolerant ecosystems. The extraction of hydrocarbons reduces subsurface pressure and has led to much faster subsidence in areas near extraction activities than elsewhere (Day et al. 2007). To make matters worse, nutria—a beaver-sized rodent—were introduced in the 1930s for their fur but they proliferated and accelerated wetland loss because of their voracious appetite for marsh plants. Increased use of fertilisers in the catchment has raised nitrate levels fourfold and results in periodic 'dead zones' or hypoxia that can extend across large areas of the Gulf and have negative impacts on delta ecosystems. By the time Hurricane Katrina struck in 2005, an average of about 88 km^2 of delta marsh had been lost every year for five decades. Concern by local citizens, scientists, activists, the media, politicians and others grew from the 1960s, and led to increased focus on wetland restoration. The result was the creation of the Coastal Wetlands Planning, Protection and Restoration Act in 1990. Yet, despite growing concern and legislative and other efforts, the loss of delta wetlands was relentless right up to when Katrina made landfall in 2005.

Looking back over time, one could argue that laudable societal goals, such as public health and safety and economic prosperity, drove efforts to reduce flood and public health risks through levee construction and protective works, improve

navigation and provide access to natural resources by channelizing the river and cutting through the swamps. Others argue, however, that exploitation and transformation of the delta, and the growth of New Orleans in particular, is the product of more nefarious forces. For example, Freudenburg et al. (2009) contend that the demise of public safety and environmental sustainability in the delta is the product of a 'growth machine': a cabal of self-interested property developers, business tycoons and public officials who garnered public funds to undertake projects of dubious social benefit that profited a few in the short-term but created spiralling disaster risk and environmental degradation. Regardless of viewpoint, the cumulative impact of delta practices over the last century has unquestionably compromised the biophysical processes that underpin and sustain life in the region and beyond. Engineered controls and alteration of naturally occurring river flows and fluxes have starved wetlands of water, sediments and nutrients and disrupted disturbance regimes and salinity balances that sustain delta ecosystems. Extractive and exploitive practices have compounded wetland loss and are key drivers of escalating disaster risk in the delta. In his environmental history of the lower Mississippi, Morris (2012) argues that disaster risk has deeper roots than inadequate scientific understanding or poor engineering; rather, it stems from the misguided belief that people can and should separate water from land. Paradoxically, this endeavor has destroyed vital delta ecosystems and increased exposure or physical vulnerability to flooding and storms. But exposure to physical perils is only one dimension of disaster risk; the other dimension is social vulnerability (Oliver-Smith and Hoffman 2002; Wisner et al. 2004).

There is a long-standing history of vulnerability in the delta that is driven by a combination of political corruption, racial discrimination and social inequity. The 'colourful' nature of delta politics can be traced back to the early 1800s when Jean Lafitte carried out pirate operations from the bayous of Louisiana. Louisianan politicians have an unenviable reputation for corruption (Parent 2004). Huey Long, Louisiana governor from 1927 until his assassination in 1935, was notorious for his flagrant theft and corruption. Illegal activities were continued by a slew of politicians, bureaucrats and business people, including subsequent Governors who received federal prison sentences: Leche (1936–1939; mail fraud, corruption and bribery) and Edwards (1972–1996; extortion, mail fraud and money laundering). Despite efforts to 'clean up' state and local politics, such practices have continued to the present. Nine term Louisiana Congressman William Jefferson (1991–2009) received a 13 year federal prison sentence for bribery in 2009.[1] At the start of 2013, the New Orleans Mayor at the time of Katrina, Ray Nagin (2002–2010), was indicted on federal charges of corruption.[2] This political culture significantly impacted post-Katrina recovery efforts (Jurkiewicz 2007a) as explained below.

Social vulnerability in the delta has been shaped by segregation and discrimination that can be traced back to slavery. Racial disparities are more pronounced in Louisiana than most other states. From the 1960s, flood protection and federally backed insurance enabled many, especially white, New Orleanians to move into

[1] See http://www.justice.gov/opa/pr/2009/November/09-crm-1231.html

[2] See http://edition.cnn.com/2013/01/18/justice/louisiana-former-mayor-indicted

newly created suburbs in former swamplands. Public housing was constructed for a growing urban population of predominantly African Americans. Employment opportunities were limited and many poor people lived in concentrated deprivation with little prospect of a decent education, meagre access to basic social services and scant hope for the future. In 2000, the city of New Orleans had the second highest concentration of poverty among large US cities, with poverty disproportionately concentrated amongst African Americans who made up 67 % of the city but 84 % of the population below the poverty line; many living in neighbourhoods with poverty in excess of 40 %. Virtually every socio-economic indicator of life in poor neighbourhoods in pre-Katrina New Orleans painted a dismal picture. African Americans were consequently disproportionately vulnerable to the ravages of Katrina; especially because many lived in low-lying areas and had limited access to private vehicles to evacuate before the hurricane struck the city (Colten 2006b; Laska and Morrow 2006; Campanella 2007).

The combination of physical exposure to an array of hazards and social vulnerability makes disaster inevitable. A synopsis of the Katrina and BP-DWH oil spill disasters reveals important lessons about disaster risk and natural hazards planning that provide vital insights for adapting to climate change.

15.2.2 Hurricane Katrina

The Katrina tragedy has been recounted in a vast array of popular books, scientific analyses and government reviews too numerous to cite. This section briefly describes the event and recovery process to date to draw lessons for adapting to climate change (Fig. 15.2).

Hurricane Katrina severely impacted the entire Gulf Coast from Florida to Texas. Federal disaster declarations covered an area of about 233,000 km^2. It is the costliest ‘natural disaster’ in US history—total economic losses, including insured and uninsured property and flood damages amounting to about US$ 150–200 billion including about US$ 48.7 billion in private insured losses (King 2005). The most severe damage occurred along the Mississippi coast and in Louisiana, with catastrophic levee failure resulting in the flooding of approximately 80 % of New Orleans. Although about 80 % of the 1.3 million people living in the metropolitan New Orleans region evacuated ahead of Katrina, over 100,000 people were left in the city when Katrina struck. Those who remained behind were predominantly African American, poor and elderly or otherwise vulnerable. An estimated 1,836 people died as a direct or indirect result of the hurricane and associated flooding. There were many incredible stories of heroism, altruism and selflessness in the initial response. The shocking television images of people left stranded for days amidst flood waters without drinking water, food or shelter, however, exposed the wholesale failure of the government response (Schneider 2005; U.S. House of Representatives 2006; Jurkiewicz 2007b). Hurricanes Rita (Sept. 05) and then Wilma (Oct. 05) compounded devastation in the delta and made the 2005 hurricane season the worst in living memory.

Fig. 15.2 'Katrina was here'—near London Avenue Canal, New Orleans. (Source: photograph by Bruce Glavovic)

New Orleans was 'shut down' for six weeks after Katrina as the levees were repaired, flood waters pumped out and efforts made to restore basic services. The direct impact of Katrina was determined by property elevation and proximity to levee breaches. But disparities in income, race, class, gender and age shaped exposure and vulnerability to flooding and recovery prospects (Colten 2006b; Campanella 2007; Masozera et al. 2007; Finch et al. 2010). Communities in the Gulf coast faced a torrid time for years after the 2005 hurricane season. Many had to come to terms with the loss of loved ones and disruption to all aspects of life, including homes, jobs, access to critical infrastructure and public services including education and health care as well as the intangible losses of community identity and sense of place (Hawkins and Maurer 2011). Post-traumatic stress disorder and clinical depression became prevalent (Kessler et al. 2008). Many left behind the neighbourhoods they grew up in, familiar rituals and traditions and social networks, and had to start over in a new locality far from home. For those who remained behind, the post-Katrina devastation was a daily reminder of the disaster. They had to navigate a morass of red tape to secure government support and insurance payments to start the rebuild process. Economic and business continuity woes prevailed. Public infrastructure and social service provision in every sector proved challenging for years. Katrina laid bare the deep racial and class cleavages that had characterised New Orleans for decades (Dyson 2006). Nearly every facet of public and private life needed to be repaired or rebuilt, posing a monumental recovery challenge. The widely acknowledged failed response to Katrina continued well into recovery (Comfort et al. 2010). This recovery experience sheds valuable light on barriers and opportunities for adapting to climate change (Fig. 15.3).

A plethora of recovery efforts was initiated: from the federal level through to state, parish, neighbourhood and individual businesses and households (Burby 2006; Kates et al. 2006; Olshansky 2006; Nelson et al. 2007; Olshansky et al. 2008; Olshansky and Johnson 2010; Barrios 2011). FEMA and the state of Louisiana started the Long-Term Community Recovery Emergency Support Function (ESF-14) of the National Response Plan in October 2005. Local recovery efforts were fraught

Fig. 15.3 Derelict house, Lower 9th Ward, New Orleans. (Source: photograph by Bruce Glavovic)

as reflected in the chaotic recovery efforts in New Orleans. Initial formal recovery planning for the city revealed the complex and contested nature of recovery and had a perverse long-term outcome. The Mayor appointed the Bring New Orleans Back Commission (BNOBC) in September 2005 which tasked the Urban Land Institute to prepare a recovery plan that was issued three months after the flood. The technically sound plan sought to reduce risk, prioritise redevelopment resources and provide services for the anticipated smaller population. It advocated selective rebuilding of less damaged properties and a buy-out of properties in the most damaged areas so that they could be converted to open space. It was not clear what would happen to the people—predominantly African Americans—who lived in the infamous 'green dot' zones that were identified as being too risky for rebuilding. Many feared that the political and economic elite wanted to profit out of the misfortunes of others and public opposition to the plan was strident. A follow-up BNOBC plan was also rejected. The Mayor faced a political firestorm and distanced himself from the BNOBC recommendations, rendering their work impotent. Alternative recovery plans were soon in train but subsequent efforts avoided the issue of disallowing redevelopment in areas exposed to high flood risk and relocating at-risk communities. In short, local politics dictated that the city be rebuilt according to the pre-Katrina 'footprint' regardless of flood risk, let alone escalating risk in the face of climate change.

The dismal failure of initial top-down planning efforts galvanised local citizens to wrest control of recovery planning from the 'technocrats.' The City initiated a neighbourhood recovery planning process—the Neighbourhood Rebuilding Plans—that was called the Lambert Plans. Extensive public engagement underpinned these plans. In addition, a number of independent neighbourhood plans were carried out with the support of non-profit groups and universities and various projects were supported by philanthropic and faith-based organisations. Funding could not be secured from FEMA for the Lambert Plans. The Louisiana Recovery Authority (LRA), established in October 2005 to coordinate rebuilding efforts and channel federal funding to local communities and the city, initiated the Unified New Orleans Plan (UNOP) process in the summer of 2006. Funded by foundation grants, the aim was to build upon and integrate previous neighbourhood plans and guide future reconstruction investment. The UNOP, however, created some confusion and raised questions about the legitimacy of the Lambert Plans. A consolidated city plan was prepared together with 16 district plans based on extensive public consultation and professional input. The city prepared a hazard mitigation plan to secure funds from the post-disaster Hazard Mitigation Grant Program (HMGP) because there were no funds to implement the UNOP. This hurriedly compiled plan did not dovetail well with the UNOP or other plans. Normally, federal assistance for hazard mitigation requires pre-event preparation of local hazard mitigation plans. Many Louisiana communities did not have such plans in place before Katrina struck and provision was made to allow post-event plans to be developed to access this assistance. In December 2006, as the UNOP was being finalised, the city established the Mayor's Office of Recovery Management (ORM) headed by charismatic but controversial Ed Blakely. ORM prepared an implementation plan drawing on UNOP recommendations and identified 17 target recovery areas across the city that were widely supported by the public. The LRA was responsible for disbursing special disaster funds from US Dept. of Housing and Urban Development (HUD) Community Development Block Grants (CDBG) for targeted recovery projects. The ORM's plan to allocate the CDBG funds to recovery projects—the Long-Term Community Recovery Plan—was approved by the LRA in June 2007. Blakely's oft-quoted promise to have "cranes in the sky" by September 2007 was not realised. Regardless of whether or not this was a literal or metaphorical reference, the gap between 'plans' and physical reconstruction reflects the challenge of turning recovery promises into reality.

In January 2008, a US District Court found the US Army Corps of Engineers (USACE) responsible for the levee failures, a decision upheld in a federal court in 2009, but the judgement was overturned on appeal in September 2012 on the grounds that the government cannot be sued for actions that an agency or government employee makes, or fails to make, if the function is discretionary.[3] Superficially, the flooding of New Orleans was the result of an engineering failure—there were systemic flaws in the design and construction of the levees as well questionable oversight and maintenance by widely discredited levee boards. Much of the USACE recovery effort focused on repairing the levee system to protect the

[3] See http://edition.cnn.com/2012/09/25/us/louisiana-katrina-lawsuit

Fig. 15.4 Louisiana Speaks Public Meeting, New Orleans, 21 July, 2006. (Source: photograph by Bruce Glavovic)

city from a one percent storm surge event and ensure continued access to flood insurance within the levees. The federal government allocated US$ 14.6 billion to the USACE to strengthen the New Orleans Risk Reduction System based on levees, floodgates and storm surge barriers, including a 37 km long storm surge barrier eight meters high to prevent storm surge from the Gulf entering the City's inner harbour-port complex.[4] Despite opposition from USACE, MRGO was closed in 2009 as a result of growing public pressure and lack of evidence of the promised benefits (Shaffer et al. 2009). There was growing recognition that structural measures to protect against flooding and storms are not a panacea for reducing disaster risk and enabling long-term recovery for New Orleans and other delta communities. In parallel with the USACE efforts and New Orleans recovery planning, there were many other sectoral and region-wide recovery planning efforts, including the *Louisiana Speaks Regional Plan* (LRA 2007), *Louisiana Comprehensive Master Plan for a Sustainable Coast* (LACPRA 2007/2012), *USACE Louisiana Coastal Protection and Restoration Program* (NRC 2009) and parallel recovery efforts in neighbouring Mississippi and the Gulf region e.g., the Gulf of Mexico Alliance—a partnership between Gulf states that seeks to foster regional cooperation to promote the ecological and economic health of the Gulf of Mexico[5] (Fig. 15.4).

In November 2008, New Orleanians approved a change to the City Charter to prepare a Master Plan backed by the force of law that sought to remove politics from land-use choices by requiring that all zoning maps, land-use decisions, public projects and government actions conform to the Master Plan. There was vocal opposition to the proposed change, notably by some African American leaders, on the grounds that it could lead to the relocation of 'at-risk', predominantly African American neighbourhoods. Memories of the BNOB Commission's infamous 'green dot' plan were stirred—revealing persistent concerns about the role of race and class in the city's recovery, and mistrust and fear about the role planning could play in

[4] See http://www.mvn.usace.army.mil/Missions/HSDRRS?RiskReductionPlan.aspx

[5] See http://www.gulfofmexicoalliance.org/index.php

perpetuating inequitable development. The City of New Orleans' first ever Master Plan was adopted in 2010 with a legally enforceable Comprehensive Zoning Ordinance that was in draft form at the time of writing. Among other things, the Master Plan recognises the city's dependence on protective measures such as levees and the need for 1 in 500 year flood protection. It also recognises that the long-term sustainability of the city is dependent on wetland restoration. The draft Zoning Ordinance introduces a range of measures that are intended to help people learn to live with the reality of abundant water and flood risk by adopting measures such as passive surface and groundwater management strategies.[6]

Overall, some 20 recovery related planning processes were undertaken in New Orleans between 2005 and 2010. This array of plans ostensibly engaged the public in the crucial process of charting recovery pathways for communities in the city and beyond. Many people had, however, had their lives turned upside down by the 2005 hurricanes, were profoundly disappointed in the dismal government response and then had had to participate in a slew of official and unofficial planning processes that seemed to overlap and duplicate each other. At the same time, people were trying to get their lives back together and deal with frustratingly slow responses from government and insurance companies, the challenges of getting repairs and rebuilding done, kick-start businesses and communities as well as become familiar with and respond to USACE levee repair plans, state Road Home and Hazard Mitigation programmes, Small Business Administration support, changes to building codes and other planning processes for the schooling system, wetland restoration, public health and justice systems, etc. To compound matters, Hurricanes Gustav and Ike necessitated evacuation of the region in 2008 and caused a hiatus in recovery planning and implementation efforts. The global financial crisis further compounded recovery woes. Despite commitments from every level of government and manifold recovery plans and initiatives supported by the allocation of billions of dollars of recovery funding, the post-Katrina recovery process has been convoluted and plagued by controversy from the initial response through to the present, especially in New Orleans. In April 2010, the BP-DWH oil spill subjected delta communities to yet another disaster that reopened still raw wounds from the 2005 hurricane season.

15.2.3 BP-DWH Oil Spill

The BP-DWH platform burst into flames on the 20th of April 2010, killing 11 workers and injuring another 17. The story of this disaster has been recounted in many books, analysed in detail by government agencies and appointed bodies including the President appointed National Commission on the BP-DWH oil spill and Offshore Drilling (National Commission 2011) and an array of scientific studies.[7] Within a month of the blowout, President Obama[8] said:

[6] See http://new.nola.gov/city-planning/master-plan/

[7] This section distils aspects of a study by Glavovic (2013a).

[8] Remarks by the President to the Nation on the BP oil spill, 15 June 2010, http://www.whitehouse.gov/the-press-office/remarks-president-nation-bp-oil-spill (Accessed 17 December, 2012).

> Already, this oil spill is the worst environmental disaster America has ever faced. And unlike an earthquake or a hurricane, it is not a single event that does its damage in a matter of minutes or days. The millions of gallons of oil that have spilled into the Gulf of Mexico are more like an epidemic, one that we will be fighting for months and even years.

The blowout occurred in about 1,500 m of water when an exploratory well was being drilled to a depth of about 4,000 m below the seabed in the Macondo Prospect some 66 km off the Louisiana coast in the US Exclusive Economic Zone. Containing a blowout at such depth is extraordinarily difficult and it took 87 days to do so; after about five million barrels of crude oil had been unleashed into the Gulf. Every effort was made to stem the flow of oil and contain damage, including removing it from the water, diluting and dispersing oil in less sensitive areas and keeping it on the surface away from sensitive areas. Over 6.8 million l of dispersant were used—an unprecedented amount—notwithstanding potential impacts on human health as well as wider environmental health issues (Solomon and Janssen 2010). Initially, some 200,000 km^2 of the US EEZ were closed to fishing with major impacts on commercial and recreational fishers as well as direct and indirect impacts on those whose livelihoods were reliant on Gulf ecosystems (Gill et al. 2012; Lee and Blanchard 2012). A preliminary estimate indicated that the loss of ecosystem services could range from US$ 34–670 billion (Costanza et al. 2010). But the full extent of the impacts of the oil spill disaster is difficult to assess with precision and will be revealed in years to come (National Commission 2011; Committee on the Effects of the Deepwater Horizon Mississippi Canyon-252 oil spill on Ecosystem Services in the Gulf of Mexico 2012; Gill et al. 2012; Silliman et al. 2012).

By mid-2012, media sources[9] calculated that BP would face costs in the order of US$ 38 billion—including some US$ 14 billion in response and clean-up costs, US$ 1 billion in restoration projects, US$ 9 billion in compensation pay-outs and US$ 7.8 billion to resolve outstanding claims. The company faces a slew of court cases. In November 2012, BP representatives were found guilty of criminal charges and agreed to pay US$ 4 billion to the US Justice Department and a further US$ 525 million to the US Securities and Exchange Commission for misleading investigators about the rate of oil flow into the Gulf. The company has been denied access to US government contracts because of a ‘lack of business integrity’. Sprawling civil proceedings began in 2013 as the US Government and others sought as much as US$ 17 billion in civil damages under the Clean Water Act and other statutes.

The National Commission (2011, p. vii), issued in January 2011, provides valuable insights into the causes of this disaster:

- The explosion and subsequent sinking of the DWH well could have been prevented.
- Key parties made identifiable mistakes that caused the blowout and reveal systemic failures in risk management that raise questions about the safety culture of the entire industry.

[9] See http://www.guardian.co.uk/business/2012/jul/31/bp-deepwater-horizon-costs

- Oil and gas exploration and production in deep water pushes the boundaries of experience and creates risks for which neither the industry nor government have been adequately prepared.
- Regulatory reforms have been instituted since the disaster. But regulatory oversight of leasing, energy exploration and production reforms need to go much further to ensure human and environmental safety. Fundamental reform is needed in how regulatory agencies are structured and how they make decisions to ensure political autonomy, build technical expertise and enable full consideration of environmental concerns.
- Regulatory oversight per sê will not be sufficient. The oil and gas industry will be required to take its own, unilateral steps to improve safety throughout the industry.
- There is a significant lag between the technology, laws and regulations and practices for containing, responding to and cleaning up oil spills compared to the technology innovations that enable drilling into large, high-pressure reservoirs of oil and gas located far offshore and thousands of meters below the sea-surface and sea-bed. This gap needs to be closed, with active industry involvement and support rather than resistance.
- Much remains to be done to improve understanding about the environmental conditions in sensitive environments in deep Gulf waters, the region's coastal habitats and in areas proposed for more drilling, such as the Arctic; as well as the human and ecological impacts of oil spills.

Among other things, the BP-DWH oil spill disaster refocused attention on the imperative to halt the destruction of coastal wetlands and restore the valuable ecosystems of the delta. The scale and complexity of this undertaking was underscored by the intricacies of the oil spill response and recovery process. Massive financial investment and the coordinated involvement of all levels of government and key actors from the private sector, civil society and scientific community are required (Stokstad 2010; Barbier 2011; Bjorndal et al. 2011). Paradoxically, the BP-DWH oil spill disaster has been a source of funding for wetland restoration, with about US$ 2.5 billion already going to research and restoration as a result of the criminal proceedings and fine (Malakoff 2012).

What lessons can be learned from recent disaster experiences that will enable delta communities to build layers of resilience as a buffer against waves of adversity that will get progressively worse with climate change?

15.3 Institutionalising Lessons Learned from Recent Delta Disasters

Learning from past experience to build more adaptive and resilient social-ecological systems is crucially important. Colten and Sumpter (2009) point out that the tabulation of lessons is necessary but not sufficient for averting future disasters.

They remind us that pledges were made after Hurricane Betsy to ensure that nothing like that disaster ever occurred again in Louisiana. Yet, between that time and 2005, practices continued apace that further unravelled the resilience of the delta and its communities. What might be done to ensure that the lessons learned from recent disasters become part of the social memory of the delta and are institutionalised to build more resilient and adaptive practices and livelihoods? Moreover, in the turbulent world of climate change, how can delta communities learn to live with uncertainty and cope with surprise? This section will first provide an overview of the state of recovery and future prospects after the recent disasters, and the global recession that started in 2008. It will then identify key imperatives for the delta in the face of climate change.

15.3.1 The State of Recovery in and Future Prospects for the Delta

There are diverse information sources and divergent views about the state of recovery in New Orleans and the delta region. Notwithstanding USACE improvements to the flood protection system, the 2005 hurricanes increased exposure to coastal storms by transforming about 260 km^2 of marsh into open water in southeast Louisiana[10]—an area that had been projected to be lost over a 50 year period. There have been significant improvements but social vulnerability persists.[11] Census data shows that in mid-2011, the New Orleans population was 74 % of its 2000 population of about 485,000 people; and the population levels of the wider metro region had reached 90 %. The city was the fastest growing large US city between 2010 and 2011. The metro region is more diverse than it was pre-Katrina, with the percentage of Latinos growing to 63 % between 2000 and 2011. The proportion of African Americans in the city declined from 67 % in 2000 to 59 % in 2011. There is evidence of improvements in various measures of employment and entrepreneurship, tax revenues, aspects of school performance and declining numbers of blighted residences. Other trends, however, reflect the struggle that many continue to face. The mainstay industries of the regional economy—oil and gas, shipping and logistics and tourism—have been in decline and have shed tens of thousands of jobs since 1980. The BP-DWH oil spill and moratorium negatively impacted related employment and livelihoods. Unemployment in the metro region rose between 2007 and 2012; and foreclosures on mortgages rose between 2008 and 2012. The poverty level in the city of New Orleans remains stubbornly at 29 %, the same level as it was in 1999. Post-Katrina housing is more unaffordable and violent crime is nearly twice the national rate. New Orleans is ranked first for corruption and third in its concentration of poverty in the top 100 US metro areas. Louisiana continues to be

[10] See http://www.nwrc.usgs.gov/releases/pr05_007.htm

[11] See http://www.gnocdc.org/

one of the poorest states in the US—with more than 25 % living below the poverty line and poverty levels have climbed in recent years. The state ties for second in percentage of people living below the poverty line, has the second-highest rate of infant mortality, and ranks fourth in violent crime, 49th in life expectancy and 46th in percentage of people older than 25 with college degrees. Katrina Road Home grants have all but been disbursed and no one still lives in a FEMA trailer. But there are still billions of dollars of government recovery funds yet to be dispersed, including US$ 3.5 billion from FEMA for debris removal and infrastructure repairs.

Why, despite massive recovery investment and effort, has it been so difficult to reduce long-term exposure to coastal storms and reverse social vulnerability; and what does this portend for the future?

Every level of government, and most public leaders, have been harshly criticised for failing to adequately prepare for and respond to the widely predicted disaster; and this failure persisted well into recovery. There were some successes in the government response including intergovernmental cooperation that helped to facilitate pre-landfall evacuation, mobilisation of the National Guard and the search and rescue operations of the US Coast Guard and Louisiana Department of Wildlife and Fisheries (Derthick 2007). But these successes were overshadowed by systemic government failure. Key non-governmental actors, including the Red Cross, were also severely criticised for inadequate preparation and response; and there was ineffective coordination between the public, voluntary and private sectors (Ink 2006; Edwards 2009). Overall, independent studies and reviews show that despite good intentions and the laudable efforts by many, Katrina exposed flaws in virtually every aspect of disaster governance: from failed initiative and leadership (U.S. House of Representatives 2006) to multiple failures in accountability regimes, and systemic flaws in among other things emergency management, engineering, economics, environmental management and inter-governmental cooperation (Cigler 2007). Koliba et al. (2011) argue that Katrina represents one of the most severe breakdowns in governance networks in modern history.

The BP-DWH oil spill reveals congruent insights. It would be naive to think that punishing BP is a panacea for averting future oil spill disasters or that it will halt unsustainable practices in the delta. As the history of the region shows, it will take much more than reforming a single corporation, or even the entire energy sector and associated regulatory framework, to secure the health, safety and sustainability of delta ecosystems and communities. The thinking and practices that drove delta exploitation for at least a century need to be transformed (Bergin 2011; National Commission (2011; Gramling and Freudenburg 2012; Lustgarten 2012). Many analysts argue that future oil spill disasters will be averted only if the underlying drivers of disaster risk are confronted, including, among other things, the pervasive influence of corporate power, corruption and a lack of accountability; a ‘timid’ congress; the complexity of socio-technological risk in the twenty-first century; government de-regulation; dependence on fossil fuels; and deep societal resistance to embracing a safe and clean energy future (Bergin 2011; Freudenburg and Gramling 2011; Gramling and Freudenburg 2012; Hoffman and Jennings 2011; Juhasz 2011;

Fig. 15.5 Living on the Edge—Grand Bayou, Louisiana. (Source: photograph by Bruce Glavovic)

Ladd 2012; Lustgarten 2012). But there are scant prospects of such fundamental reform. Two years after the BP-DWH oil spill disaster, one of the two scientists on the National Commission wrote that the US is "largely failing to act on the lessons learned from that experience to ensure that deep-water drilling and production is safe and environmentally compatible" (Boesch 2012). (Fig. 15.5).

The 'big questions' revealed by Katrina and the BP-DWH oil spill therefore go beyond apportioning blame to individuals, firms or agencies. They concern the roles, responsibilities and interactions of key actors from government, civil society and the private sector in creating the conditions that make disasters inevitable; the role of governments in reducing disaster risk and building resilience; and how to institutionalise the harrowing lessons learned (Cigler 2007; Freudenburg and Gramling 2011; Gramling and Freudenburg 2012). Drivers of delta disaster risk are rooted in exposure to an array of perils and the region's history of racism, poverty and inequity and culture of corruption (Cobb 1992; Woods 1998; Campanella 2007; Jurkiewicz 2007a), that has been compounded by the insidious impacts of the 'growth machine' (Freudenburg et al. 2009) and the misguided attempt to separate water from the land (Morris 2012). Many of those living in the delta face waves of adversity that will worsen in coming decades. Is recent 'recovery' experience a troubling harbinger of things to come? Will climate change deepen physical vulnerability and exacerbate inequities between rich and poor in the region (Mutter 2010)? Or will recent experiences galvanise efforts and lead to a sea-change in thinking and practices in the delta? Averting future disasters necessitates protection or relocation of those most 'at risk' and the reversal of social vulnerability, including the drivers of racism, poverty, inequality and social dysfunction (e.g., high levels of violent crime); waning economic opportunities; aging and dilapidated physical infrastructure; and a political legacy of corruption, nepotism and cronyism that casts a dark shadow over delta governance. This exploration of delta history, unsustainable resource practices, disaster risk, vulnerability and resilience reveal four imperatives for the region.

Fig. 15.6 Shrimp boat near Grand Isle, Louisiana. (Source: photograph by Bruce Glavovic)

15.3.2 Delta Imperatives

Four major lessons or imperatives have been brought to the fore by recent disasters (Fig. 15.6).

First, stem wetland loss and restore delta ecosystems: The Katrina and the BP-DWH oil spill disasters underscore the critical importance of arresting wetland loss and restoring delta ecosystems to sustain coastal livelihoods and reduce disaster risk, not to mention the intrinsic value of the wetlands and delta stewardship obligations. Concern about wetland loss and the restoration imperative grew from the 1960s. The upshot of nearly two decades of campaigning led to plans developed by a coalition of all levels of Government called Coast 2050, approved in 1998, that carried an implementation price tag of about US$ 14 billion over 30 years. The White House baulked at this cost and a more modest follow up plan was developed. Despite numerous projects initiated from the 1990s, these efforts remained small-scale and piecemeal. After Katrina, it was recognised that the cost of effective wetland restoration will be significantly higher than previously estimated. The State of Louisiana developed a Coastal Master Plan, initially approved in 2007 and revised in 2012 (LACPRA 2007/2012). The new plan carries a price tag of US$ 50 billion to carry out 109 fully funded projects that will improve flood protection and create a 'sustainable coast.' Recent disasters underscore the need to integrate flood protection and coastal restoration. A 'multiple lines of defence' strategy has been advocated based on complementary measures including restoring barrier islands and shorelines, stabilising banks and shorelines and creating marshes; structural works such as engineered floodwalls, floodgates and levees; non-structural options such as elevating buildings, property acquisition and permanent relocation and land-use zoning and building codes. The Coastal Master Plan recognises this multi-pronged approach. Paradoxically, however, the issue of climate change has been muted in publicly distributed documents because of the contentious nature of this topic in the delta—even though the significance of this issue is well-known to

scientists and many others in the region. Rampant coastal erosion and wetland loss is sufficient to galvanise political and public attention without having to invoke climate change risk in support of the imperative to restore delta ecosystems. This imperative has become ever more urgent and compelling given that significant areas of the existing delta will be inundated even if sediment loads in the Mississippi river are restored because projected sea-level rise is at least three times faster than it was during the construction of the delta plain (Blum and Roberts 2009, 2012). Restoration efforts will have to become even more intensive in coming years to offset climate change impacts; and these efforts will need to become less energy-intensive given the anticipated rising cost of energy (Day et al. 2005). But there are extraordinarily complex legal, political, fiscal, institutional and cultural obstacles to translating intentions into practical reality. Securing the necessary funding and implementing the plan will require the coordinated and active engagement of all levels of government in partnership with key stakeholders from the private sector, civil society and the scientific community. The Katrina and BP-DWH oil spill recovery processes underscore the vexed nature of such a complex and contested endeavour.

Second, overcome the safe development paradox: Burby (2006) describes the paradoxical consequence of efforts to reduce modest risk associated with high frequency events such as annual flooding by constructing levees that leads to a false sense of security and intensified development within the levees and potentially catastrophic impacts when a low probability event exceeds design standards. Burby (2006, p. 178) argues that the catastrophic flooding of New Orleans "could be viewed as an expected consequence of federal policy rather than an aberration that is unlikely to be repeated." Measures that compel local communities to assume the risk burden of development choices may help to overcome this paradox. But, as revealed by historic practices in the delta, century old practices of ill-advised development—driven by self-interest and short-term thinking—have prioritised financial gain over environmental stewardship, undermining the natural defences of the wetlands and predisposed delta communities and especially New Orleanians to disaster. The only sure way to overcome the safe development paradox is to avoid putting people in harm's way, and where necessary to relocate at risk communities. This overly simplistic prescriptive action is the only sure way to avoid exposure to natural hazards. Once physical development has occurred in at-risk localities, there is understandably deep resistance to relocate or retreat. In the face of escalating climate change driven disaster risk, there is, however, a compelling need to shift from the predominant reliance on 'hard-engineering' protective measures towards approaches that chart sequenced adaptation pathways, including retreat from high risk localities at critical thresholds when the social costs of protection outweigh social benefits. Katrina and the BP oil spill, reinforced by changing perceptions about climate change as a result of extreme weather events, such as Hurricane Sandy in New York state in 2012 (Smith and Jenkins 2013), have brought to the fore alternative options for adapting to climate change, including their incorporation into among other things the Coastal Master Plan. Reducing exposure to storms and other perils is, however, only one dimension of disaster risk reduction (Fig. 15.7).

Fig. 15.7 Mitigation measures, Grand Isle, Louisiana. (Source: photograph by Bruce Glavovic)

Third, address the drivers and root causes of social vulnerability that predispose marginalised groups and communities to disaster: This lesson was cruelly underscored by Katrina (Laska and Morrow 2006). It had long been known that many New Orleanians lacked the financial, human and other resources necessary for coping with a major storm event, let alone catastrophic flooding. A major disaster in New Orleans had been predicted for more than a decade and the location of the worst devastation and who would be impacted had even been anticipated (Laska 2004; van Heerden and Bryan 2006). Katrina unequivocally showed that the drivers and root causes of poverty and inequity need to be confronted if disaster risk is to be reduced. The BP-DWH oil spill reinforced this imperative. Formal and informal institutions and processes shape social choices and mediate access and entitlement to a range of resources and assets necessary for building layers of resilience. Exclusion or marginalisation from political processes and markets institutionalise poverty and inequality and increase social vulnerability and hence disaster risk. Public planning and decision-making processes, including those aiming to reduce disaster risk and build resilient and sustainable communities, are thus imbued with the realities of politics and power which need to be confronted in the design and management of efforts to reverse social vulnerability. The foregoing

Fig. 15.8 Building community resilience. (Source: photograph by Bruce Glavovic)

three imperatives are dependent on fundamental reforms to the architecture of disaster governance (Fig. 15.8).

Fourth, reframe governance thinking and praxis that drive disaster risk by causing environmental degradation and social vulnerability: Disaster governance is an emerging concept in the disaster literature (Tierney 2012) that is qualitatively different from terms like emergency management, disaster management or disaster risk reduction that tend to focus on hands-on actions, often by government, to mitigate impacts before, during and after a major event. Disaster management is a misnomer because by definition disasters are not 'manageable'—they are hazard events that exceed the coping capacity of affected populations. 'Governance' is a well-established but hotly debated term in diverse literatures (e.g., Rhodes 1996, 1997; Stoker 2000; Newman 2001; Bang 2003; Kooiman 2003; Boyte 2005). The term is apt for disaster studies and practice, and natural hazards planning in particular (Glavovic 2010; Glavovic et al. 2010), and especially valuable insights can be gleaned from literatures on environmental (e.g., Lemos and Agrawal 2006; Newell et al. 2012) and risk (e.g., Renn 2008; Aven and Renn 2010; Renn et al. 2011; Klinke and Renn 2012) governance. Drawing from this diverse scholarship, I use the term 'disaster governance' to refer to the steering activities of interacting government, civil society and private sector actors as they seek to diminish the prospect and impacts of disasters. Interactions may be deliberate or inadvertent and take place through a gamut of formal and informal institutions, actor networks and practices. Steering activities include norms, taboos, laws, policies and practices invoked by social groups at different scales (from local to international levels and over time) to collectively address the array of sudden shock and slow-onset perils society faces. Katrina and the BP-DWH oil spill reveal the diversity of actors and institutions that create, bear and share disaster risk and how their interactions shape exposure and vulnerability to hazard events and to building long-term resilience and adaptive capacity or paradoxically entrench pre-event vulnerabilities that predispose communities to repeat disasters. The failure of disaster

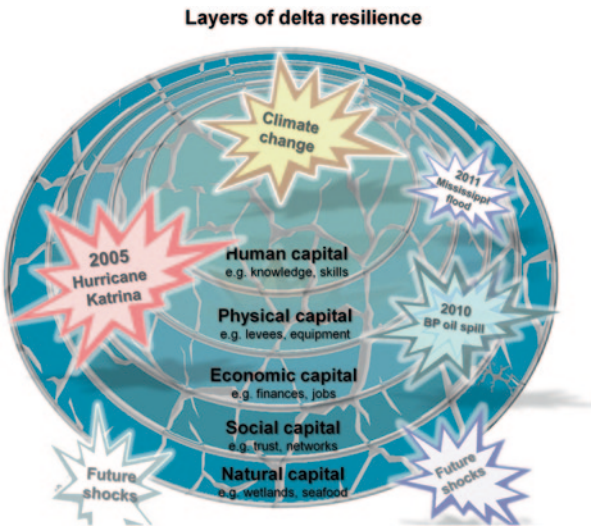

Fig. 15.9 Waves of Adversity, Layers of Resilience. (Source: Bruce Glavovic, drawn by Paul Schneider)

governance in Katrina and in the BP-DWH oil spill reflects the systemic failure of wider governance networks to effectively advance environmental stewardship and equity. Successive US governments have actively or at best tacitly encouraged rampant and often high-risk exploitation of delta resources with perfunctory regulatory oversight (Gramling and Freudenburg 2012). Building more resilient, adaptive and sustainable delta communities thus requires transformation of prevailing disaster governance thinking and praxis.

Addressing these four imperatives in a coherent manner requires a paradigm shift in thinking about the value of the delta; how to sustainably use deltaic resources and build culturally, socially, economically and ecologically sustainable livelihoods; and in the process reduce exposure and vulnerability and build resilience. Charting development pathways that are adaptive and sustainable necessitates the building of layers of resilience to buffer waves of adversity that are compounded and exacerbated by climate change. What then are the barriers for mainstreaming climate change adaptation into planning and decision-making in the Mississippi delta region; and how can these be converted into opportunities?

15.4 Barriers and Opportunities for Building Resilience and Adapting to Climate Change

Figure 15.9 illustrates notional layers of resilience that will help to buffer delta communities against waves of adversity.

Delta communities need to build ‘thick’ layers of resilience or robust ‘critical infrastructure’ to cope with sudden shocks and plan for and adapt to change in ways

that minimise exposure and sensitivity to climate change impacts. The history of delta disasters reveals the juxtaposition of coupled community resilience and vulnerability in the delta (see Gotham and Campanella 2011). Vulnerability fissures and fractures weaken extant layers of resilience that need to be repaired and 'thickened'. This notion builds upon and extends the 'multiple lines of defence' strategy. But the latter implies a resistance orientation that is not well aligned to the uncertain and turbulent reality of climate change. Building layers of resilience is thus an apt metaphor and necessitates among other things restoring and maintaining the health, productivity and integrity of coastal wetlands; providing robust public infrastructure, including flood protection works; fostering economic well-being whilst acting as stewards of climate-sensitive resources; strengthening social capital; eradicating poverty and inequality; and building inclusive governance institutions that include effective research, monitoring, public awareness and communication systems. One way of thinking about how to translate barriers into opportunities for building layers of resilience is to use the metaphor of 'capital':

Human capital: This typically refers to the stock of knowledge, competencies and attributes including education, health, entrepreneurship and skills that enable people to contribute to economic and social life. A broader perspective includes the implicit attitudes and knowledge that confer social advantage; described by Bourdieu (1986) as 'cultural capital'. I use the term human capital to include both the 'technical' and 'cultural' dimensions of knowledge and experience that shape public perceptions and awareness of and attitudes towards disaster risk and sustainability; and to reflect that learning takes place in a social context. There are strong anti-reflexive tendencies in influential circles in the US towards the issue of climate change and sustainability more generally, including "merchants of doubt" (Oreskes and Conway 2010) who deliberately obfuscate the unequivocal scientific evidence of global warming that is very likely driven by human actions (IPCC 2007; see e.g., McCright and Dunlap 2010). Reluctance to make explicit reference to climate change in the Coastal Master Plan is indicative of the knowledge, attitudinal and institutional barriers that need to be overcome. Stimulating reflexivity (self-conscious and self-critical reflection on oneself and society) is crucial for developing the human capital necessary to deepen and extend individual and societal adaptive capacity and resilience. An important starting point is to understand better the nature of risk, the value of ecosystem services and the complexity of coupled social-ecological systems. Integrating such understanding into public planning and decision-making is challenging given the difficulty of bridging the science-policy-practice gap, especially with respect to climate change (Watson 2005). Evolving resilience and risk governance scholarship and praxis underscores the crucial role that social learning plays in helping to bridge this gap (Adger 2003; Folke 2006; Klinke and Renn 2012).

Physical capital: Investment in physical capital, including factors of production such as equipment and machinery as well as public infrastructure such as roads and protective works, is vital for economic productivity and public safety. Well established communities seek to maintain social stability and secure existing investments in property and infrastructure and are thus likely to prioritise 'hard engineering'

protective works as a defence against natural hazards such as floods and storms over 'soft engineering' or 'design with nature' (McHarg 1971) approaches. There is a compelling but understandable proclivity to resist change and defend societal investment. But, as the 'safe development paradox' indicates, such resistance can prove to be maladaptive in the long-term, especially in the face of climate change and escalating disaster risk. Alternative development pathways that are adaptive, resilient and sustainable therefore need to be explored. Long-term strategic planning provides a distinctive opportunity to chart such pathways. Initiatives such as the Coastal Master Plan demonstrate that physical capital, such as levees, is an integral component of a 'multiple lines of defence' strategy, and that innovative design and management measures geared towards 'living with water' offer practical alternatives to traditional 'defensive' strategies. Reframing this defensive strategy towards one that embraces change and builds 'layers of resilience' is compelling but challenging.

Economic capital: The pursuit of private gain and accumulation of financial capital helps to build vibrant communities through job creation and economic development. But relentless prioritisation of short-term profit and economic growth at the expense of ecological sustainability and social equity can among other things escalate disaster risk and reduce livelihood options and community resilience and sustainability. Increasing attention is being focused on developing alternative economic models that take into account the value of ecological services, the nature of risk and the complex inter-connected nature of social-ecological systems (Daly 2005; Costanza et al. 2006; Batker et al. 2010). Such approaches seek to integrate short- and long-term considerations; reconcile private and public interests; and equitably distribute risk, and costs and benefits, to shareholders, stakeholders and citizens. Translating such laudable intentions into practical reality is, however, vexed. But as the recovery experience in the delta demonstrates, there are positive indications that economic interests are being viewed in a wider context of sustainability and resilience.

Social capital: This concept is contested but broadly speaking connotes the value of reciprocal relationships or social networks (Coleman 1988; Portes 1998). Notwithstanding evidence of widespread declining social capital (Putnam 1995, 2000), Solnit (2010) shows that, remarkably, in the worst of circumstances, people engage in altruistic and compassionate social actions that help to rebuild shattered communities. In the immediate aftermath of disaster, community members engage in practical social actions that are powerful catalysts for building social capital. There is a strong positive relationship between social capital and community resilience in general (Murphy 2007) and in preparing for, responding to and recovering from disasters (Chamlee-Wright and Storr 2011). Natural hazards planning processes that explore, share and build on these positive community experiences can thus help to build social capital and strengthen resilience. The challenge is to overcome the established patterns of social behaviour and governance institutions and practices that become dominant after disasters and close down the flourish of transient communities of mutual aid that arise organically in adversity (see Solnit 2010). Social capital is thus imbued with power and politics. Political systems and practices that alienate

and marginalise particular groups or communities result in inequitable entitlements to the range of assets at the disposal of communities, thus increasing social vulnerability and disaster risk—as Katrina poignantly showed. Deepening and extending democracy through authentic public participation is thus pivotal to natural hazards planning and decision-making processes that build social capital and 'thicken' layers of community resilience.

Natural capital: The land, air, water, living organisms and all formations of the biosphere can be thought of as natural capital that provides humanity with ecosystem goods and services essential for survival and well-being (Daly 1990, 2005). Traditional measures of economic performance ignore the value of natural (and social) capital and hence it is neglected relative to human, physical and economic capital. Consequently, natural systems are over-exploited and degraded. The incredible value of the delta's natural capital has been highlighted above and its recognition is integral to securing the requisite investment to restore delta wetlands and build layers of resilience. But to secure the delta's natural capital, and overcome the drivers of unsustainable development stemming from the prevailing hegemony, there is a need to institutionalise approaches that among other things: Maintain environmental diversity and redundancy; manage connectivity; manage slow variables and feedbacks; foster understanding of complex social-ecological systems as adaptive systems; encourage social learning and experimentation; broaden and deepen public participation; and promote multi-scalar and multi-level governance systems (Biggs et al. 2012).

Building human, physical, economic, social and natural capital in the delta in the face of climate change is a 'super wicked problem' for which there are no panaceas. Past coastal innovations (such as deep water drilling for oil) have unwittingly accelerated unsustainable use of coastal resources in general and the delta in particular. Paradoxically, innovation is needed to escape the vulnerability trap that past innovation has set (Glavovic 2013b). A transformative practice of deliberative coastal governance provides a framework for navigating the fraught transition to coastal sustainability (Glavovic 2013c) and 'thickening' the layers of delta resilience.

Importantly, these layers of resilience do not exist in isolation; they are mutually supportive: Delta resilience as a whole is greater than the sum of the individual layers of resilience.

15.5 Towards Deliberative Delta Governance

Deliberative delta governance is recommended to address the delta imperatives and overcome the barriers and unlock the opportunities outlined above. The framework proposed by Glavovic (2013c) explains why a deliberative approach is needed to facilitate the transition towards coastal resilience and sustainability, and how this can be achieved. The framework builds upon and extends the Orders of Outcomes framework developed by Olsen and colleagues (Olsen 2002, 2003; Olsen et al. 2009) which recognises that pursuit of coastal sustainability starts with the creation of

enabling conditions for sustained implementation through agreed goals, supportive and informed constituencies, implementation capacity, and commitments to invest in implementation. Only once the first Order of Outcomes is in place can progress be made towards the second Order of Outcomes, *implementation through changed behaviour*, and then the third, *achieving targeted environmental and societal outcomes*, and the elusive fourth Order of Outcomes, *sustainable coastal development*. Progress to higher Orders of Outcomes is challenging because of maladaptive path dependencies and 'lock-in' due to unsustainable 'business as usual' practices. Glavovic (2013c) argues that the above Orders of Outcomes need to be underpinned by four *deliberative or process outcomes* that provide an essential platform for realising the *coastal outcomes* described by Olsen and colleagues. The foundational pillars for deliberative delta governance are briefly summarised here and readers are referred to Glavovic (2013c) for more detailed explanation.

Deliberation is a non-coercive process of communicative interaction between social actors that stimulates reflection on societal values, preferences and interests in making social choices (Dryzek 2000). It can take place in both formal and informal public settings and involves much more than 'talking'. It includes information sharing, discussion and debate that matures with practice and social learning and enables participants to make well-informed public decisions (Chambers 2003). Deliberation needs to be authentic, inclusive and consequential if it is to yield legitimate social outcomes (Dryzek 2009) and facilitate the transition to sustainable development (Fisher 2000; Baber and Bartlett 2005; Dryzek 2011).

The first pillar of deliberative delta governance is to understand the nature of delta risk and issues, and improve democratic attitudes and skills. 'Safe arenas' for public deliberation need to be created to enable participants to explore and develop a shared understanding of delta concerns. Deliberation can engage and integrate different types of knowledge and knowledge claims, including traditional disciplinary science and local and traditional knowledge. In so doing, coastal concerns, including climate risk, resilience and adaptation options and pathways, can be explored in ways that promote social learning and enhance both the 'technical' and 'cultural' dimensions of human capital referred to above. Deliberation can also help to raise awareness and foster deeper appreciation and tolerance of divergent viewpoints. Democratic attitudes and interpersonal communication skills and judgement can also be improved with deliberative practice that enhances group interactions and decision-making processes.

The second pillar of deliberative delta governance is to catalyse community-oriented action and improve institutional capacity and decision-making. Delta history highlights the difficulty of achieving collective action in the face of strident individualism or where community members are alienated or marginalised from public decision-making processes. Inclusive deliberation helps to build a common purpose and stimulates participation in community activities. It provides a foundation for reconciling contending interests, strengthens community institutional capacity and decision-making competency and enhances the legitimacy of community decisions.

The third pillar of deliberative delta governance is to deepen community problem-solving capacity. Deliberation helps participants' reframe and improve their understanding of delta risk and issues, strengthens institutional capacity and decision-making and engages community members more constructively in community life on a sustained basis. In practice, however, understanding and resolving complex and contested intra-community problems is a difficult and protracted process. Deliberation helps to overcome the barriers and unlocks opportunities explored above to develop community problem-solving capacity over time.

The fourth pillar is facilitating inter-community collaboration through cross-scalar and multi-level processes of authentic and inclusive dialogue, visioning, negotiation and cooperation. Such polycentric deliberation takes place in formal and informal collaborative arenas. Addressing delta risk and adapting to climate change cannot progress meaningfully without being framed in this wider governance milieu. Both intra- and inter-community deliberation is necessary to build layers of resilience and foster delta sustainability.

15.6 Priority Practical Actions for Adapting to Climate Change

Three practical priority actions are recommended for building community resilience, adaptive capacity and sustainability based on the notion of deliberative delta governance outlined above.

First, articulate, share and celebrate community narratives about overcoming adversity and building community resilience and sustainability. Much can be learned from local 'success stories' and the pathways that offer promise for buffering communities against the waves of adversity that are compounded and exacerbated by climate change. For example, Chamlee-Wright and Storr (2011) demonstrate that collective narratives can shape individual recovery strategies. In their study of St. Bernard parish they found that individual strategies emphasised self-reliance informed by a shared narrative of being a close-knit, family-oriented community made up of hard-working people. "Social capital in the form of collective narratives, we contend, shaped the disaster response and recovery efforts in St. Bernard Parish and helps to explain the surprising signs of resilience in that community" (Chamlee-Wright and Storr 2011, p. 267). Sharing community narratives about overcoming adversity does not imply avoiding self-critical reflection on mistakes made and lessons learned from failed initiatives. Much can be gained by deliberate and reflexive learning from both success and failure. The challenge is then to institutionalise lessons learned.

Second, design inclusive processes of local community disaster risk reduction and resilience planning. The deliberative delta governance approach advocated here is predicated on inclusive processes of authentic public engagement, civic science and social learning. The appropriate modalities for engagement and who should participate need to be contingent on the characteristics of the delta risk and

issues under consideration. The convoluted and contested New Orleans recovery planning process underscores the complex and inherently political character of such endeavours. A trusted mediator can help to create the necessary 'safe spaces' that enable community voices to be heard, including marginalised voices, and conflicting interests to be resolved.

Third, region-wide strategic collaborative planning processes are needed to address issues that are beyond the influence of local communities and create the deep-rooted inertia that results in unsustainable and maladaptive outcomes. Whilst the deliberative delta governance approach outlined above progresses from lower to higher Orders of Outcomes in a generally sequential manner (albeit not in an inexorable linear fashion), building inter-community deliberative capacity is likely to be fostered by first building intra-community deliberative capacity. Delta- and even Gulf-wide initiatives, such as the Gulf of Mexico Alliance, provide encouraging evidence of the emergence of collaborative initiatives that transcend particular interests or geographical communities.

15.7 Conclusion

This chapter has shown that the Mississippi delta is made up of social-ecological systems of immense value. Delta communities face a range of perils and have prevailed despite many disasters, including floods, hurricanes and oil spills. Past and prevailing practices are, however, unsustainable and coastal livelihoods are imperilled. To compound matters, the delta is a global hotspot for climate change impacts and sea-level rise in particular. Disaster risk is escalating. Delta communities need to build layers of resilience as a protective barrier against waves of adversity that are likely to intensify with climate change. Recent disasters have exposed the paradox of conjoint resilience and vulnerability; though different groups and communities have varying levels of each over time. There is nonetheless, seemingly inexorable pressure to rebuild 'as before' and 'return to normal' after a disaster. Such a hankering for the physical reconstruction of the past, whilst understandable, is invariably unwise and nigh impossible to realise in practice. There is a post-disaster window of opportunity to chart new pathways that avoid recreating the exposure and vulnerabilities that predisposed communities to disaster in the first place. Recovery choices are, however, complex and contested. Innovative modalities of collaborative planning, and courageous leadership by key actors in government, the private sector civil society, the research community and media, are needed to expedite recovery and make wise choices that foster community resilience and sustainability.

Delta history Katrina and the BP-DWH oil spill reveal four delta imperatives. First, stem wetland loss and restore delta ecosystems to sustain coastal livelihoods and reduce disaster risk in the face of climate change. Second, overcome the 'safe development paradox' created by reliance on structural flood protection measures and explore alternative adaption pathways. Third, address the drivers and root

causes of social vulnerability that predispose marginalised groups and communities to disaster. Fourth, reframe governance thinking and praxis that drive disaster risk by causing environmental degradation and social vulnerability. Addressing these four imperatives in a coherent manner requires a paradigm shift in thinking about the value of the wetlands; how to sustainably use deltaic resources and build culturally, socially, economically and ecologically sustainable livelihoods; and reduce disaster risk and vulnerability, and build resilience in the face of climate change.

Barriers and opportunities for mainstreaming climate change adaptation into planning and decision-making in the delta are explored with respect to the different forms of capital (human, physical, economic, social and natural capital) that together construct layers of resilience. Efforts to reduce disaster risk, plan for different hazards, including pre-event planning and post-disaster recovery, and navigate the turbulent waters of future climate change, need to be framed as a practice of deliberative delta governance. Four pillars rooted in deliberation are foundational to such an approach: First, build understanding of risk and coastal issues, and improve democratic attitudes and skills. Second, foster community-oriented action and improve institutional capacity and decision-making. Third, deepen community problem-solving capacity. Fourth, facilitate inter-community collaboration through sustained processes of authentic and inclusive dialogue, visioning, negotiation and cooperation.

Finally, three priority actions are recommended for building community resilience, adaptive capacity and sustainability based on the recommended deliberative delta governance approach. First, articulate, share and celebrate community narratives about disasters, risk and resilience. Much can be learned from local 'success stories' and the pathways that offer promise for buffering communities against the waves of adversity that are compounded and exacerbated by climate change. Second, design inclusive processes of local community disaster risk reduction and resilience planning. A trusted mediator can help to ensure that all voices are heard and conflicting interests resolved. Third, delta- and region-wide strategic collaborative planning processes are needed to address issues that are beyond the influence of local communities and create the deep-rooted inertia that results in unsustainable and maladaptive outcomes.

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