Katrina recovery experiences: Imperatives for building sustainable, hazard-resilient communities

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Abstract

The consequences of living in hazard-prone areas were brought home by graphic television coverage of the hurricanes that devastated the Gulf coast of the USA in 2005. Hurricane Katrina, in particular, highlighted the compelling need to build more sustainable and hazard-resilient communities. Much can be learned from recovery efforts to rebuild the Gulf coast. Personal observations and interviews with planners, academics and others involved in recovery efforts inform this analysis, which focuses on New Orleans. A conceptual framework is developed and substantive and process principles outlined to guide action for building sustainable, hazard-resilient communities drawing on insights from diverse literatures, including coastal management, natural hazards planning, collaborative planning, sustainable communities, sustainable livelihoods, ecological economics, environmental governance, adaptive management and co-management. Building sustainable, hazard-resilient communities will remain elusive unless 'business as usual' is confronted by a transformational process of developmental planning. Sustainable, hazard-resilient coastal communities are founded upon robust 'critical infrastructure' (including ecological, political, social, livelihood and physical dimensions) that is secured by planning and decision-making processes that enable coastal communities to build 'layers of resilience' to overcome 'waves of adversity'.

Keywords: Hurricane Katrina, sustainability, hazard-resilient communities

Introduction

In late August 2005, the world was shocked by television coverage of the dismal US Government response to the plight of about 100,000 people who were stranded by the levee failure-induced flooding of New Orleans in the aftermath of Hurricane Katrina. Despite massive reconstruction efforts over the last two and a half years, the current circumstances and future prospects of many Gulf Coast communities, and New Orleanians in particular, remain deeply problematical. How can we meet basic human needs in the face of disasters and build more sustainable and hazard-resilient communities? Post-Katrina reconstruction experiences provide valuable lessons for 'building back

better' and averting future catastrophes. For practical reasons, attention here is focused on the role of land-use planning in post-Katrina reconstruction efforts in New Orleans. My reflections are based on five visits to the region between July 2006 and September 2007. Personal observations and interviews with planners, academics and others involved in recovery efforts inform this analysis. Insights are also drawn from diverse literatures pertinent to this subject. These reflections provide a foundation for developing a conceptual framework and defining substantive and process principles to guide action for building sustainable, hazard-resilient communities.

The Katrina experience: Vulnerability+hurricane = catastrophe

Hurricane Katrina, which had made landfall on the 29th of August 2005, is the most devastating hazard event in US history. Although it is difficult to determine the precise number of hurricane-related deaths, indications are that more than 1,720 people died as a consequence of Katrina (Natural Hazards Center, 2006; Bergal et al., 2007). New Orleanians account for most of these deaths. About 80% of the city was flooded when the levees failed. The entire city was 'closed' by mandatory evacuation and no public services were available for about six weeks after the deluge – an unprecedented experience in US history. The economic impacts may reach hundreds of billions of dollars; and the social impacts will be felt for decades (Petterson et al., 2006). Hurricane Rita struck less than a month later – killing 120 people and causing about USD 10 billion of damage, mostly in southwestern Louisiana. The hurricanes affected a vast area – approaching the size of New Zealand. They impacted the Gulf coast in very different ways – cf. storm surge on the Mississippi coast versus flooding in New Orleans – and recovery experiences and prospects are similarly diverse. This section focuses on the circumstances that led to the flooding of New Orleans, the role of planning in reconstruction efforts, and lessons learned from these efforts.

Waves of adversity and a history of vulnerability

For centuries, the coastal wetlands of Louisiana have provided an abundance of resources and a home for people from diverse cultures. But this region, and the city of New Orleans in particular, is vulnerable to flooding from the Mississippi and Atchafalaya rivers and to the impact of coastal storms. To compound matters, the coastline is subsiding. The wetlands that historically served as a natural defense against storms have been dramatically reduced and transformed by a combination of, among other things, habitat destruction; dredging and cutting channels for navigation purposes and oil and gas pipelines, and associated resource extraction. Moreover, the channelisation of the Mississippi river has all but stopped sediment supply to the coast. In short, human exploitation and alteration of the Louisiana wetlands has systematically altered the coastline causing pollution and significantly

increasing the biophysical vulnerability of this region to floods and storms (Austin, 2006; Campanella, 2006).

Despite 'waves of adversity' – coastal storms, floods, disease, wars, etc. – New Orleans has persisted for over 300 years. Even though economic prospects have waned in recent decades, the city remains a strategic gateway for imports and exports, and is a vital part of the region's petrochemical, seafood and tourism industries. New Orleans is an iconic melting pot of cultures. It had a long history of native American settlement before more recent Spanish, French, Irish, Italian, African and other cultural influences that have shaped the city's *genius loci*. Cajun and Creole cultures are much celebrated today. New Orleans is a distinctive place of ritual, famous for its celebration of Mardis Gras, second line parades, Jazz Festival and other special occasions. It is the music mecca of the USA - the home of jazz. It is a place of incredible cuisine. It boasts distinctive architecture that gives special character to close-knit communities and vibrant neighbourhoods.

It took about 200 years to wrest the city from nature (Colten, 2005). Historical development was concentrated on the higher ground. But with the expansion of protective works in the 20th century, residential developments spread out into low-lying areas. Many parts of the city and surrounding suburbs are now located in a bowl below sea-level with the Mississippi River on the one side and Lake Pontchartrain on the other. Many New Orleanians are thus dependent on an elaborate series of levees and pump stations. The physical vulnerability of the city has long been recognised. When New Orleans flooded, all residents in the bowl – white and black; rich and poor – were flooded. The extent of flooding was a product of topography – not wealth or class or race (Colten, 2006), though affluent suburbs tend to be located on higher ground. The key factor affecting vulnerability to the rising waters was the ability to evacuate, i.e., mobility: those who lacked access to private motor vehicles – the poor, infirm, aged, immobile – were stuck; some 20% of the city's pre-Katrina population of about 455,000 people. Those with wealth and access to private vehicles were able to escape the rising flood waters even if they suffered economic loss. They were also more readily able to return to rebuild their lives. Those lacking transport and other means became reliant on public evacuation and accommodation and other Government support; making their return more problematical and difficult. Katrina tragically exposed the physical vulnerability of the city and region. But it was the levee failure and subsequent flooding of New Orleans that laid bare the political and socio-economic vulnerability of the city and its marginalised residents in particular.

New Orleans' burden of vulnerability has been borne by different communities over time – previously by low-income Italian and Irish communities and more recently by poor predominantly African American communities (Colten, 2005). Katrina was a natural disaster – exceeding the capacity of affected communities to cope with the hurricane impacts. But Katrina became a 'man-made disaster' of catastrophic proportions because of the social vulnerability of New Orleans and the dismal failure of public institutions at all levels – from the local to Federal level – to protect citizens (viz. the levee failure), evacuate

them and provide a timely and effective emergency response. This vulnerability will persist until its underlying drivers are addressed, including declining economic opportunities; poverty, inequality and social dysfunction (including high levels of violent crime); aging and dilapidated physical infrastructure; and a political culture of corruption, nepotism and cronyism (Comfort, 2006; Laska & Morrow, 2007).

The Katrina-induced diaspora from New Orleans and the wider Gulf coast region resulted in more than 1.5 million people being scattered across the USA. At the start of 2008, the population of New Orleans was about 300,000 people or 65% of the pre-Katrina population. The plight of tens of thousands of New Orleanians and other former-Gulf Coast residents was and continues to be desperate. Virtually every aspect of life continues to be adversely affected by the 2005 hurricanes. Many families have had to come to terms with the loss of loved ones and they suffer ongoing clinical depression and post-traumatic stress disorders. Profound loss of identity and sense of place is commonplace. Many face a daily commute through blighted neighbourhoods. And many who have returned and rebuilt their homes live in 'jack-o-lantern' neighbourhoods – isolated lights in an empty darkness. Those now living away from the city have had to adapt to life in new surrounds – detached from social networks, traditions, and the many tangible and intangible qualities that constitute 'home' and 'community'. The hurricanes exposed deep racial and class cleavages that continue to bedevil some communities and the city as a whole (Dyson, 2006). Public infrastructure and social services continue to be problematical in many neighbourhoods. Many businesses have faced tremendous hardship and economic prospects are bleak for a number of sectors. Environmental impacts also pose ongoing challenges. Rebuilding the schools, public health system and other social services is a monumental task. Not surprisingly, there is deep distrust of government and its ability and even desire to assist communities in rebuilding their lives.

The 2005 hurricanes thus constitute a mega-catastrophe for which there are no 'silver-bullet' solutions. Characterised by vast scale and complexity, reconstruction and recovery must confront a legacy of political, economic, social, cultural, infrastructural, institutional and environmental vulnerabilities whilst opening up new opportunities for rebuilding resilient and sustainable livelihoods. This challenge will continue to face generations of Gulf Coast residents and the USA as a whole. It necessitates unprecedented commitment and new collaborative partnerships within and between Government at all levels, civil society and the private sector.

Post-Katrina recovery planning: Persistent vulnerability despite 'plans'

Katrina prompted remarkable acts of heroism, generosity and selflessness – in sharp contrast to the depressing television portrayal of looting and lawlessness. Despite the utter failure of the Government's initial response, extensive recovery efforts are underway and will continue well into the future. Planning and related recovery initiatives have been driven by a range of

agencies and organisations from the national to local level across the Gulf States. In Louisiana alone, there are many state-wide initiatives to stimulate recovery and 'build back better', including: the Road Home Programme which is designed to compensate homeowners for damage sustained during the hurricanes; the Coastal Protection and Restoration Authority of Louisiana's Comprehensive Master Plan for a Sustainable Coast; and the Louisiana Speaks' Regional Plan developed under the aegis of the Louisiana Recovery Authority (LRA). In New Orleans alone there have been five citywide recovery planning initiatives since Katrina.

The Bring New Orleans Back (BNOB) Commission was appointed by the Mayor in September 2005. A technically sound plan was produced focusing on urban design issues and land-use options that would reduce future flood risks, prioritise redevelopment resources and maintain services for the anticipated smaller population. But the process did not create opportunity for meaningful public participation – people were scattered across the US! The findings sparked outrage by those still struggling to come to terms with the devastation. There was no clarity about what would happen to the people who had lived in the infamous 'green dot' zones that were identified as being too risky for rebuilding. Faced with a political firestorm, the Mayor retreated from the Commission, rendering their work impotent.

In early 2006, a neighbourhood planning process was started by the City Council – the New Orleans Neighbourhoods Rebuilding Plan (NONRP) or commonly called the Lambert Plans. Active resident involvement in the process helped to shape a more popular outcome. However, the assumption was that all areas of the city would be rebuild – effectively ignoring the differential risk and long term safety of the most vulnerable neighbourhoods.

The LRA, the state agency established to coordinate rebuilding efforts and channel Federal support to local communities and the city, initiated another planning process in the summer of 2006. The purported rationale was that the LRA would only accept a plan that was citywide and encompassed both flooded and unflooded neighbourhoods. The emergence of a new planning process created considerable confusion and raised questions about the legitimacy of the NONRP process. The LRA's Unified New Orleans Plan (UNOP) was reshaped to integrate previous planning processes into a single plan that would guide future reconstruction investment. The plan was carried out at district and citywide scales – yielding 13 district plans and a citywide plan. Earlier neighbourhood planning processes fed into the district plans and offered design and land-use planning solutions. The citywide plan focused on policy- and regulatory mechanisms in an effort to prioritise rebuilding and foster safer future development.

In January 2007, as UNOP was being finalised, the Mayor established the Office of Recovery Management (ORM) to coordinate the overall recovery process in the city. The charismatic leader of the ORM and his team of professionals identified 17 'target areas' for investment that would act as catalysts for further development. But securing the necessary funding to have

'cranes in the sky' has proved difficult; and those outside target areas are understandably concerned about their recovery prospects.

In addition to these major citywide planning initiatives, there have been a host of other planning and -related initiatives that are either sector specific (e.g., housing, schools, public health, etc.) or neighbourhood specific (e.g., the People's Plan for Rebuilding the 9th Ward).

Nelson et al. (2007) point out that rebuilding in the aftermath of Katrina raises two key challenges. Firstly, how to enable residents to return to the city without recreating the deep vulnerabilities that existed before Katrina. Secondly, how to prioritise available resources for redevelopment. They argue that a citywide recovery strategy was needed to address these challenges. They also highlight two tensions that bedevilled the planning processes: the concomitant contradictory need for speed and deliberation (Olshansky, 2006); and the tension between 'expert' and public input to the planning process. Nelson et al. (2007) argue that the development of a coherent citywide rebuilding strategy was significantly slowed down by the failure of the city to designate a single agency with the mandate and authority to facilitate the necessary comprehensive recovery planning process.

So, where do things stand after more than two and a half years of recovery planning? In short – most New Orleanians are frustrated with the slow pace of recovery. Many neighbourhoods in New Orleans remain all but abandoned and derelict. Sporadic and ad hoc rebuilding is taking place irrespective of hazard-risks. Tens of thousands of people who were dispersed by Katrina continue to struggle and still await insurance and government payouts. Based on my discussions with many planners and professionals involved in diverse aspects of the recovery process, it is clear that pre-Katrina vulnerabilities are likely to remain in place for the foreseeable future; and that well-intended planning efforts may result in little more than marginal improvements to the city's sustainability and resilience:

- The loss of critical wetland habitat seems destined to continue despite general agreement on the need to restore these treasured coastal ecosystems.
- The cause of the levee failure has been studied and re-studied, and repairs and improvements have and are being made. But protection against storms more intense than a Category 3 hurricane is not available and will not be established for decades.
- Dysfunctional institutions and fraught inter-organisational relationships have compounded response and recovery difficulties – from exacerbating confusion about the recovery process to causing delays in releasing funds for essential recovery work. Rebuilding social and governmental institutions in the aftermath of Katrina is challenging but imperative.
- Leadership failure in the aftermath of Katrina paradoxically stimulated grassroots activism and community-driven planning that has transformative potential (Irazábal & Neville, 2007). However, community activism needs to be complemented by institutional leadership in order to translate well-intentioned plans into 'projects on the ground'.

- Rebuilding is taking place across the city, including in some of the most 'at risk' neighbourhoods. The 'right to rebuild' trumps concerns about risk avoidance and long-term community safety. Reconciling the desire to 'return to normal' with the need to mitigate future risks poses a conundrum that needs to be confronted.
- Finally, the complex mix of political, economic and social factors that constructed the profile of poverty and inequity in the city persists. Even though many poorer New Orleanians have yet to return to the city, continued social vulnerability is a harbinger of future catastrophe.

Tragically, the conditions that gave rise to pre-Katrina vulnerability seem to be entrenched. Despite the prospect of intensified hurricanes and climate change impacts such as sea level rise, rebuilding is taking place as if the future was 'hurricane-proof'. People are desperately trying to 'return to normal'. But another hurricane is inevitable. And, in the face of persistent physical and social vulnerability, future impacts could be even more devastating than those experienced after Katrina. What can we learn from recent scholarship about the nature of sustainable, hazard-resilient communities and what can be done to build such communities?

Towards sustainable, hazard-resilient communities[1]

A conceptual framework is outlined to highlight key features of sustainable, hazard-resilient communities, drawing on eclectic literatures, including sustainable livelihoods (Carney 2002), sustainable communities (Beatley 1998), integrated coastal management (Stojanovic et al. 2004; Olsen et al. 2005), collaborative planning (Wondolleck and Yaffee 2000), co-management (Olsson et al. 2004), resilience studies (Adger et al. 2005); and natural hazards mitigation (Mileti 1999), together with practical experience and lessons learned from recent coastal catastrophes (ISDR 2006; Pomeroy et al. 2006).

A conceptual framework to orient thinking and practice

In the past, hazards events have been dealt with in a response-driven manner with a compelling focus on saving lives, providing emergency relief and marshalling resources for restoration and reconstruction. More recently, it has been recognised that these vital measures need to be complemented by a more holistic, proactive and developmental approach that seeks to address pre-event vulnerabilities (Oliver-Smith & Hoffman, 2002; Wisner, et al., 2004). This proactive approach is key to building more resilient communities. A hazard event, such as a hurricane, only becomes a disaster when the capacity of the community, city or region to cope with the event is exceeded.

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[1] This section draws from a presentation made at the American Fisheries Society Symposium (Glavovic, in press).

Resilience is thus the reverse of vulnerability – it is the capacity of coupled socio-ecological systems to absorb hazard impacts and retain vital structures, processes and feedback functions. Resilience comprises self-organising capabilities, and learning and adaptive capacities (Adger et al., 2005). Communities that are sustainable and hazard-resilient are able to cope with and even learn from hazard events. They are able to adapt to surprise and changing circumstances. Avoiding and mitigating hazard risks is central to building sustainable, hazard-resilient communities.

Over the last decade, a range of studies have demonstrated that land-use planning is essential for building such communities (e.g., Burby 1998; Mileti, 1999). Planning offers two invaluable approaches: a 'locational' approach that restricts development in hazardous areas to avoid hazard risks and minimise future losses. In the process, it preserves environmental qualities and retains public open space. It also adopts a 'design' approach that employs design criteria and building standards to ensure 'safer' development in at-risk areas given the likely scale and intensity of anticipated hazards. More fundamentally, planners have to enable communities to confront and transform prevailing unsustainable practices that undermine socio-ecological resilience. The conceptual framework portrayed in Figure 1 provides a guide to thinking and practice. It portrays interacting elements of coupled socio-ecological systems, drawing on insights from ecological economics (Costanza 1991; Daly 2005), resilience studies (Berkes and Folke 1998; Gunderson and Holling 2002; Berkes et al. 2003; Walker and Salt 2006), and sustainable livelihoods (Chambers 1987; Chambers and Conway 1992; Carney 2002).
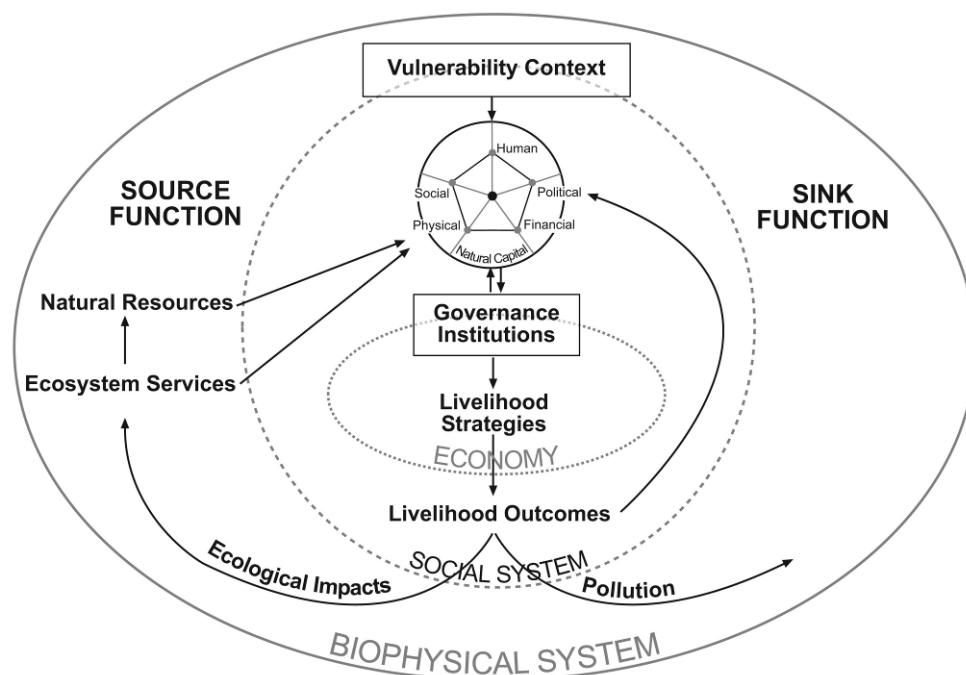

Figure 1: Sustainable Socio-ecological Systems (Source: Glavovic 2008: 316).

This framework underscores three features that are central to understanding the nature of sustainable, hazard-resilient communities. Firstly, human and natural systems are not only interconnected, they are coupled with human systems embedded in natural systems. The economy is a sub-system of socio-political and cultural systems that together are embedded in the earth's ecological systems. People are not separate from nature: humans and natural systems are an intertwined and integrated system – one complex system of systems with recursive coupling between the inter-linked human and natural elements. Fundamental constraints on these coupled systems are set by biophysical limits – as defined by the laws of matter and energy. Nature is a 'source' of an array of goods and services ('resources'). These resources are finite and if depleted or degraded can result in the transformation and even collapse of vital ecosystem functions and services. Renewable resources need to be used within their natural rates of regeneration; and non-renewable resources need to be used prudently to ensure that suitable substitutes are developed or discovered to avert irreversible losses. Nature also provides a 'sink' function – absorbing and purifying wastes – provided emissions and human waste do not exceed the assimilative capacity of ecosystems. Despite prevailing rhetoric, unconstrained economic growth is logically impossible. Learning to live within carrying capacity of natural systems is the root challenge of the ecological dimension of sustainability. Ignoring biophysical limits compromises ecological integrity and adversely affects ecosystem health and functionality, and consequently, human health and well-being.

Secondly, and following from the foregoing, human-in-nature systems are complex living systems. Such systems do not lend themselves to reductionism. These systems are characterised by complex interconnections, diversity, dynamism, unpredictability, non-linearity, evolutionary behaviour and critical feedback loops. There are complex and poorly understood interactions between and within scales from the local to global level and across time. These systems have emergent properties that cannot be understood by isolating components and re-aggregating them. In short, the whole is greater than the sum of the parts. And our knowledge of and understanding about how human-in-nature systems work, and how we can wisely manage them, is incomplete. Whilst these systems are resilient, they are subject to critical thresholds. Given the rate and scale of human impacts across the globe, critical thresholds are being transgressed giving rise to potentially irreversible and devastating impacts that imperil human well-being. In light of the emerging appreciation of this complex reality, new approaches to understanding and managing socio-ecological systems are being developed (Gunderson & Holling, 2002). And, there is growing recognition of the need to develop and foster a new sustainability ethic that takes cognisance of the needs and freedoms of both current and future generations, as well as the intrinsic value of nature.

Thirdly, translating emerging understanding into practice highlights the essential role played by governance institutions in mediating access to these resources. Coastal communities, for example, make choices about how to use available resources in the context of particular vulnerabilities – environmental,

political, social and economic trends (e.g., changes in available fish stocks or changes in human demographics as people move to the coast) and shocks (e.g., a major coastal storm or financial crisis). Coastal resource users draw upon various combinations of livelihood assets (e.g., natural capital such as fish for food; human capital such as fishing knowledge and skills; physical capital such as harbour infrastructure and boats, etc.). These assets can be traded off or substituted depending on the livelihood strategies pursued – as reflected in the asset pentagon, which may provide insights for possible entry points for development interventions. Access to these assets is primarily determined by governance institutions: the prevailing political, social and economic norms and 'rules' that structure public policies and decision-making. These governance institutions mediate access to critical livelihood assets; and consequently frame the opportunities for and constraints on user groups in their pursuit of alternative livelihood strategies. These choices, in turn, affect how resources are used and consequently the direct and indirect impacts on the source and sink functions of ecosystems; and ultimately feedback and affect the portfolio of livelihood assets available to communities.

This brief overview draws attention to key factors for building sustainable, hazard-resilient communities. It highlights the fundamental interconnection between political, social, economic and cultural systems – and the way in which natural systems are coupled with and embed human systems. Moreover, governance institutions mediate access to resources and structure subsequent livelihood choices and outcomes. Ultimately, governance institutions and processes, including property rights, access to education and health care, social exclusion, vulnerability, political marginalisation and power imbalances, play a more fundamental role in determining the sustainability and resilience of coastal communities than does the biophysical setting and range of hazard threats. Sustainable, hazard-resilient communities need to be founded on robust critical infrastructure that is developed through the application of a set of integrated principles and operational imperatives.

Critical infrastructure for sustainable, hazard-resilient communities

The term 'critical infrastructure' is typically used to describe those material assets that are fundamental to a well-functioning society, including power supply, telecommunications, water supply, public health, etc. The underlying drivers of the Katrina catastrophe, and the insights gained from the above conceptual framework, direct attention towards other non-material forms of critical infrastructure. What then is the scope of the critical infrastructure that is needed to deepen and extend community resilience and sustainability?

- **Ecological infrastructure:** Diverse, healthy and productive coastal ecosystems are essential for meeting the needs of coastal communities and providing vital goods and services, including a potentially life-saving 'eco-shield' against coastal storms and wind events.

- **Cultural infrastructure:** Local traditions, customs and social memory about resource use enables people to respond to environmental feedback and build community cohesion.
- **Social infrastructure:** Strong social ties, norms and networks build trust that facilitates cooperation and community development.
- **Political infrastructure:** Transparent, accountable and devolved public decision-making processes are essential to empower coastal communities.
- **Human infrastructure:** Aware and capable citizens have access to resources, skills and knowledge, and are thus able to make wiser decisions about issues affecting their future.
- **Economic and financial infrastructure:** A diverse economy and access to affordable financial resources are essential to establish and maintain small businesses and pursue sustainable livelihood alternatives.
- **Physical infrastructure:** Resilient physical infrastructure and public facilities are required to meet community needs in the face of recurring hazard events.
- **Household infrastructure:** Individuals need to plan and provide for themselves and their dependents so that they can become self-reliant in the face of adversity.

Developing and safeguarding such infrastructure requires transformative and developmental planning processes that empower communities to build 'layers of resilience' to cope with 'waves of adversity' – a process that needs to be guided by clear principles and operational imperatives.

Principles and operational imperatives for building sustainable, hazard-resilient communities

The following principles will help to guide efforts:

1. Put people first.
2. Develop responsive and participatory processes.
3. Prioritise empowerment.
4. Prioritise ecological sustainability.
5. Adopt a proactive and strategic but precautionary approach.

Operational imperatives to translate these principles into practice include:

1. Adopt an integrated, multi-level and holistic approach.
2. Vigorously manage mitigation and 'mainstream' natural hazards planning into decision-making processes.
3. Adapt to local circumstances, build and mobilise local capacity and foster local responsibility.
4. Identify, understand and address the needs of vulnerable communities and groups.
5. Focus on priority sectors and critical assets.

6. Strengthen information networks and proactively share information to inform, solicit feedback and raise public awareness.
7. Focus special attention on securing the buy-in and commitment of leaders from the State and private sectors and civil society.
8. Capitalise on disaster.
9. Adopt flexible and iterative processes in the face of a dynamic and uncertain future.
10. Monitor, review and adapt planning and decision-making processes.

Coastal communities need to be empowered to work collaboratively to devise solutions that translate these general principles and operational imperatives into locally relevant and culturally appropriate policies and practices.

Conclusion

New Orleans has a long history of physical and social vulnerability. Failure to address the underlying drivers of the city's vulnerability, coupled with the botched Government response to Katrina, turned a natural disaster into a human catastrophe. There is a compelling need to address the root causes of this vulnerability; and, in the process, develop robust critical infrastructure to foster sustainability and resilience. The conceptual framework, and principles and operational imperatives, outlined in this paper provide a guide for developing a transformational process of developmental planning that may help to empower communities to build 'layers of resilience' to cope with future 'waves of adversity'.

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Bruce grew up in South Africa. He has a Bachelor's degree in Economics and Agricultural Economics (University of Natal), a Master's degree in Environmental Science (University of Cape Town), and a Master's degree in Planning and a PhD in Environmental Science both from the University of Virginia. He has worked as an environmental scientist and planner in academia, private consulting and Government for more than 20 years, mainly in southern Africa, the United States and New Zealand.

Bruce's research focuses on the role of planning in building sustainable, hazard-resilient communities. It is clustered around several themes: natural hazards planning; negotiation, collaborative planning and consensus building processes; integrated environmental management (with a particular focus on coastal, ocean and water resources); adapting to climate change; and understanding poverty-environment linkages and driving forces. He is currently exploring the experiences and lessons learned in the Gulf Coast in the aftermath of the 2005 hurricanes, and in Indonesia and the Maldives in the aftermath of the 2004 Indian Ocean tsunami.