Chapter 12
Resilient Disaster Recovery: The Role of Health Impact Assessment

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> Governmental organizations … continue to spend heavily on hardening levees, raising existing homes, and repairing damaged facilities despite ***evidence that social, not physical, infrastructure drives resilience*** (Aldrich and Meyer 2015).
>
> …although there is growing emphasis on incorporating resilience-building efforts into the recovery process, such ***efforts tend to focus on hardening critical infrastructure and not on strengthening the health and resiliency of individuals and communities*** (Institute of Medicine 2015).

Abstract Health Impact Assessments (HIAs) offer an important way of improving infrastructure decision-making during the post-disaster recovery period. Although increasingly used in support of non-emergency planning decisions HIAs have not yet been widely adapted for disaster recovery contexts. The growing acceptance of broader definitions of health and the setting of future health goals, informed by lay preferences and perspectives as well as expert ones, are assisting the transition to new more holistic policies. Experience in New Jersey, following Hurricane Sandy, provides illustrations of infrastructure impacts and the challenges they pose to local communities. Traditional definitions of physical infrastructure are expanding to include categories like "green infrastructure" and "economic infrastructure"; experts and laypersons are also making different assessments of both the character and the salience of infrastructure needs. Multiple competing priorities for attention by survivors further constraint the degree to which infrastructure issues can be addressed by individual survivors and their families. Opportunities and barriers for the use of HIAs in disaster recovery are identified and explored. The coproduction of policies that capture varieties of knowledge and preferences about infrastructure among experts and laypeople is encouraged.

Keywords Knowledge · Co-production · Local decision-making
Super storm Sandy · New Jersey · Infrastructure

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12.1 Introduction

Resilience may be interpreted as the ability to absorb, recover from, and adapt to external shocks without impairing long-term sustainability. The creation of resilience in the wake of natural disasters is a much sought after goal of public policy (National Academy of Sciences 2012, National Research Council 2011), but there is a strong difference of opinion about how this should be accomplished. Of the two main theoretical approaches, one emphasizes the importance of physical infrastructure and privileges the role of experts in the decision-making process; the other focuses on creating social capital and elevates the role of laypersons (Chen et al 2013; Cagney et al. 2016). The first approach currently dominates the scholarly and professional literature and is heavily represented among the policies and programs of many governments. Yet, disaster-related failures of critical infrastructure ultimately affect individuals, households, and other occupants of local communities. These local groups bear a disproportionate burden of disruptions, damage, and other losses, but they have little involvement in the planning and management of infrastructure systems (de Oliveira and Fra Paleo 2016). That responsibility tends to fall within the purview of technical specialists in large public agencies, and private utility companies as well as professional engineers and planners plus transportation and communication specialists (Chang et al 2014).

This paper suggests that there is much to be gained from employing the second approach during the disaster recovery process, in this case by foregrounding local knowledge about hazards that threaten damaged places and by incorporating local lay perspectives into decision-making about infrastructure through processes of active community engagement (Wells et al 2013). Health Impact Assessments (HIAs) offer an important but neglected way of doing this.

Health Impact Assessment is a decision-support tool that employs "a systematic process that uses an array of data sources and analytic methods, and considers inputs from stakeholders to determine potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population" (NRC 2011). In recent years, researchers and policy makers have been broadening the definition of health that is employed in public discourse. Rather than being solely an attribute of individuals that is signaled by the absence of disease, health is increasingly viewed as also pertaining to the general well-being of groups and extending beyond the purely biophysical realm of the body to include environmental and economic health that contributes to collective survival and a sustainable quality of life. Health Impact Assessment (HIA) employs these wider perspectives and gives laypeople a central role in the planning and implementation of public projects. HIAs have not yet been adapted for disaster recovery contexts although they are increasingly used in support of non-emergency planning decisions. Experience in New Jersey, following Hurricane Sandy, provides illustrations of their utility and the challenges they pose to local communities that are engaged in recovery, with special attention to implications for critical infrastructure.

12.2 Public Policies for Critical Infrastructure

Definitions of critical infrastructure refer to phenomena (e.g., systems, processes, facilities, networks, assets, services) that are regarded as essential to the health, safety, security, or economic well-being of entire nations or societies (May and Koski 2013; Pescaroli and Alexander 2016; Pesch-Cronin and Marion 2016). Specific examples vary from country to country but generally include transportation and communications, energy and resource utilities (e.g., water and power systems), food, chemicals, financial services, certain manufacturing, and service industries. The protection of 16 different sectors of critical infrastructure is a high-priority goal of national government policy in the USA (U.S. Department of Homeland Security 2016).

Advocates for privileging the protection and recovery of infrastructure facilities like power stations, which are engaged in the *production* of public services, bring a number of influential arguments to the public policy table. These generally emphasize the nodality of critical infrastructures in resource networks that serve large human populations and the potential that a denial of service will set in motion a cascade of distributed consequences for myriad users (Pescaroli and Alexander 2016). The concentrated capital costs of damage and loss of income incurred by such facilities are also of significance for operating firms and their investors (Kelly 2015). Spending on infrastructure has long been viewed as a way of priming the pumps that drive economies, especially in developing countries (Anon 2014). Furthermore, the repair and development of critical infrastructure systems are fast becoming high-priority items of economic planning in affluent countries because they are perceived to offer means for generating jobs and investing surplus capital that are attractive to governments seeking ways of stimulating economic growth. Hazard management professionals who argue that spending on better protective facilities will repay dividends in the form of fewer deaths and injuries and lower costs of damage and recovery during future extreme events have often embraced this latter theme (Larson 2009).

Despite these arguments, and in contrast to them, problems at the *consumption* ends of infrastructure systems should not be judged less deserving of public attention; they too signal important disruptions, flaws, and failures, this time of the adaptive mechanisms on which individuals, families, and households rely most directly to achieve sustainable self-sufficiency and resilience.[1] The success of major public policies and programs for infrastructure depends on the degree to which the behavior of users is at variance with the assumptions and/or predictions of infrastructure system planners and managers. Disconnects between managers and users may be more than flaws in need of correction; if sufficiently troublesome, they may stimulate reassessments that open the way to entirely new ways of thinking and

[1]Individuals and collectives may be either producers or consumers, depending on the function of the infrastructure system; for example, individuals and families that *consume* water, electricity etc. also produce waste that is "consumed" by recycling and disposal sinks.

doing. In the words of complex adaptive systems theorists, such disjunctions may first trigger so-called small loop learning that aims to bring vernacular practice into line with expert-recommended actions, but then set off “large loop” learning that provokes more fundamental changes in problem conceptualization and management (Preston et al. 2016).

Infrastructure vulnerabilities became national and international concerns as a result of the terrorism attacks of September 11, 2001, in the USA and attained renewed prominence in a succession of later events including Hurricane Katrina (August 2005), the Tohoku earthquake–tsunami–nuclear radiation disaster (2011), and Super Storm/Hurricane Sandy (October 2012).

12.3 Infrastructure Impacts of Hurricane Sandy[2] in New Jersey

Hurricane Sandy is widely regarded as the second most costly hurricane to affect the USA (National Oceanic and Atmospheric Administration 2016). Most of the losses were incurred in the states of New York and New Jersey. This paper focuses on New Jersey rather than the more widely publicized experience of New York (especially New York City). The magnitude of New Jersey’s economic losses due to Sandy was similar to that of New York’s, but the mix of effects was different as well as the amount of reconstruction aid received from the federal government (Gurian 2015). In New Jersey, most of the storm-impacted infrastructure served small residential and resort towns with underfinanced local governments and a limited range of public services (Leckner et al. 2016). In contrast, New York is the country’s largest and most densely populated urban center, administered by an impressive municipal government apparatus, and it contains a vast range of flagship facilities, many with global outreach.[3] Yet, one of the advantages of studying New Jersey is that its oceanfront communities are more representative of places elsewhere along the US coast and beyond. Their infrastructure experiences are likely to have wider relevance for more people than those of New York City.

New Jersey’s aggregate economic losses during Sandy included capital costs ($37 Billion) and business losses ($30 Billion). Critical facilities such as hospitals, government offices, sewerage treatment plants, and hazard protection works were

[2]Hurricane Sandy lost intensity as it passed over New Jersey, reverting to a tropical cyclone in the process. For convenience, this paper employs the single label “hurricane” to both stages of the storm.

[3]New York City’s position as the country’s mass media capital, its status as a world financial hub, its densely populated streets, and its architectural heritage of iconic high-rise buildings all helped to attract media attention. The degree to which New York monopolized public attention is the wake of Sandy is similar to the dominance of New Orleans in accounts of the devastation wreaked by Hurricane Katrina and the low salience of storm-impacted areas in Mississippi and Alabama as well as other places (Lowe and Shaw 2010).

affected as well as transportation systems. Millions of gallons of spilled fuel oil and sewage were also washed into rivers and bays. The impacts were still being felt four years after Sandy when an infrastructure Report Card for New Jersey, issued by the American Society of Civil Engineers, awarded many of its poorest grades to energy, transportation, water, and green infrastructure systems that remained compromised by the storm (American Society of Civil Engineers 2016).

Although Sandy inflicted damage to large infrastructure facilities in New Jersey, most of the state's losses were sustained by housing and small businesses. For example, 2.4 million New Jersey households lost electrical power for significant periods and diminished water supplies affected many communities for a year or more after mains connections were broken or otherwise inoperable (Van Abs 2016; Felder and Chandramowli 2016). Over 70,000 of homes in the state were flooded with long delays in reoccupancy because of the need to replace compromised utility systems, carry out safety checks, and acquire necessary public approvals.

12.4 The Popularity of Infrastructure Measures in Post-Sandy Rebuilding

Shortly after Sandy occurred, President Obama established a Task Force to chart a path toward recovery and make recommendations about priority tasks that would improve the area's resilience. (Hurricane Sandy Rebuilding Task Force 2013) Infrastructure-related projects comprised the single largest category of recommendations. By my count, eleven of the 69 recommendations in the final report focused wholly on infrastructure and a Congressional Research Service Report identified 22 infrastructure-related recommendations (Brown 2014). A separate set of guidelines for ensuring that infrastructure resilience would be a major goal of all projects was also published (Finucane 2014). In addition, the US Department of Housing and Urban Development sponsored a Rebuild by Design program that invited interdisciplinary and international teams of professionals (planners, landscape architects, engineers, architects, ecologists, social scientists, and others) to submit innovative proposals as models of best practices that others might emulate. Six of these, that were located in or near New York City, were eventually chosen for funding (Grannis et al. 2016). All of them sought to encourage combinations of "gray" infrastructure (e.g., walls, retention basins, and other traditional engineered structures) with "green" infrastructure (e.g., wetlands, permeable surfaces, rain gardens).

The Sandy experience and its implications for infrastructure also featured prominently as foundational reference points of President Obama's Climate Action Plan that was published less than a year after the storm occurred. Although that plan's future is now in doubt (Temple 2017), the report serves as an indicator of the prominence accorded infrastructure investments throughout the country and in relation to a broad swathe of climate change risks.

Decisions about rebuilding infrastructure are among the most consequential for future generations because they establish the physical framework to which all subsequent development becomes tied. Whereas individual buildings might be modified or replaced relatively easily, the high capital costs, extended planning periods, and long projected life spans of major infrastructures make them difficult to change once embarked upon. Recovery programs also shape the health, safety, and well-being of entire communities for decades to come, not just by protecting against future physical risks but by improving health and raising the quality of living through enhancement of local environments, economies, and societal relations and, in other words, by pursing disaster recovery as a holistic process.

Given the salience, number, and variety of infrastructure recovery programs and projects that are possible, it would be highly desirable to employ a tool for assessing their likely impacts before choosing among the alternatives. Such an instrument would help to avoid recreating the potential for future disasters by avoiding actions that either add to preexisting vulnerabilities, or do not reduce them. Yet, no such tool is currently available. Decisions about recovery are increasingly made with the intention of "building back better", but exactly what "better" means and how it is to be achieved are matters rarely subject to systematic assessment (Hampen et al. 2016).

Engineers are increasingly aware of the need to design physical infrastructures to be disaster resilient from the outset (Chang 2009), but the kind of painstaking work that is necessary to select and fit specific designs to local situations generally is not possible in the wake of disasters. Moreover, even if better-designed facilities and networks were available at the appropriate time after a disaster, the environmental, sociocultural, and political economic contexts in which they will be embedded are themselves subject to change as survivors seek to fashion new replacement communities. An infrastructure system that is intended to function under "business-as-usual" assumptions about the future is likely to be inadequate if the community elects to change its growth and development trajectory. Assessment techniques and methods of many kinds are available as decision-support tools suitable for use before committing to action (Mitchell 2016) (Table 12.1). Most of these are undertaken well in advance of the project or program that is being evaluated. Very few have been developed for or are appropriate for use in post-disaster settings. Health Impact Assessments are an exception to which we will return for further analysis below.

Table 12.1 Types of assessment tools for the support of major public decisions

Assessment tool
Environmental Impact Assessment (EIA)
Strategic Environmental Assessment (SEA)
Social Impact Assessment (SIA)
Sustainability Assessment
Climate Impact Assessment
Ecological Impact Assessment
Cultural Heritage Impact Assessment
Regulatory Impact Assessment
Integrated Impact Assessment
Health Impact Assessment (HIA)
Health Equity Impact Assessment

Sources Mitchell (2016), Mindell et al. (2003), Renda (2006), Public Health England (2007), Haber (2010), Mendell (2010), Centers for Disease Control and Prevention (2012), Pope et al (2013), World Bank (2011), Acharibasam and Noble (2014)

12.5 Infrastructure and Infrastructure Issues: Differences Among the Assessments of Lay Residents, Local Leaders, and Experts Involved in Sandy Recovery

The assumptions on which infrastructure planning and management are based should be clear before such actions commence. Moreover, the concerns and expectations of individuals, families, and households that are scheduled to play their part in recovery actions should not be widely divergent from those of the experts and public leaders expected to oversee infrastructure initiatives. To what extent were the parties to Sandy recovery possessed of similar knowledge bases?

Data and findings from a study of risk redefinition among different municipal populations of Monmouth County, New Jersey, in the wake of Hurricane Sandy cast light on the process of infrastructure recovery (Leckner et al 2016; Mitchell et al 2016). Three case study communities were exposed to different types and degrees of risk and experienced Sandy in different ways (Figs. 12.1, 12.2 12.3 and 12.4). In Manasquan, on the oceanfront, Sandy's storm surge arrived at high tide and damaged more than 800 homes and small businesses. Somewhat later, the surge reached Union Beach, located on a more sheltered part of Raritan Bay, and damaged or destroyed 1400 houses. Thereafter, rising water pushed inland up the Shrewsbury River to Oceanport where 400 more houses recorded damage.

Six months after, the storm extended interviews were carried out with ten municipal leaders and six focus group discussions were convened involving forty-five residents. Analysis of data from these sources revealed significant differences in storm surge flood risk assessment between locals (leaders and residents)

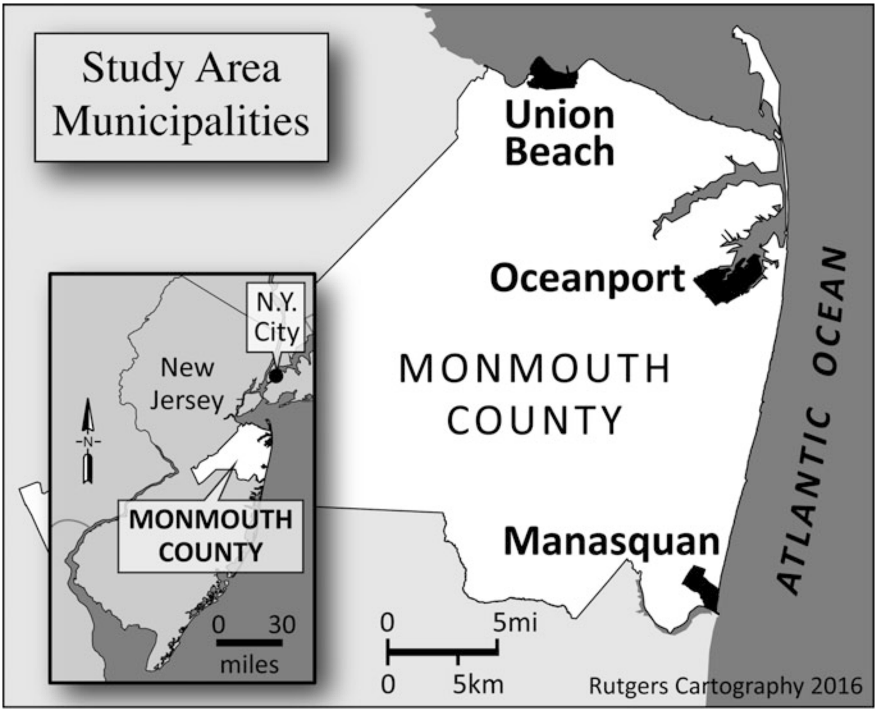

Fig. 12.1 Case study municipalities. *Source* Mitchell et al (2016)

and the experts whose knowledge underlies the main public policy instruments for regulating flood risks (Mitchell et al. 2016). These are summarized as follows:

- Compared to the expert knowledge system, the local hazard knowledge system is **more retrospective and qualitative**, as well as more **conceptually and methodologically expansive**. It routinely incorporates a **wider range of risks**, employs **more risk indicators**, **weights them differently,** and attaches more importance to microscale considerations that are often unique to specific sites. The **locals' spatial gaze is narrower** than the experts', being generally confined to a homeowner's lot and its immediate neighborhood.
- Expert and local (vernacular) risk assessment systems both privilege information about water depths and flood zones, but **the local system also incorporates knowledge about a wide variety of other (non-hydrological) variables**.
- In the local system, **information about previous floods dominates and provides emotional cues** that mobilize and reinforce personal meanings of flood events; the expert system employs retrospective information mainly as a basis for assessing future risks.
- **Relocation is a recessive risk-reduction alternative.** Remaining in place is much preferred. **Higher = safer is a widely accepted rule of thumb**. Experts

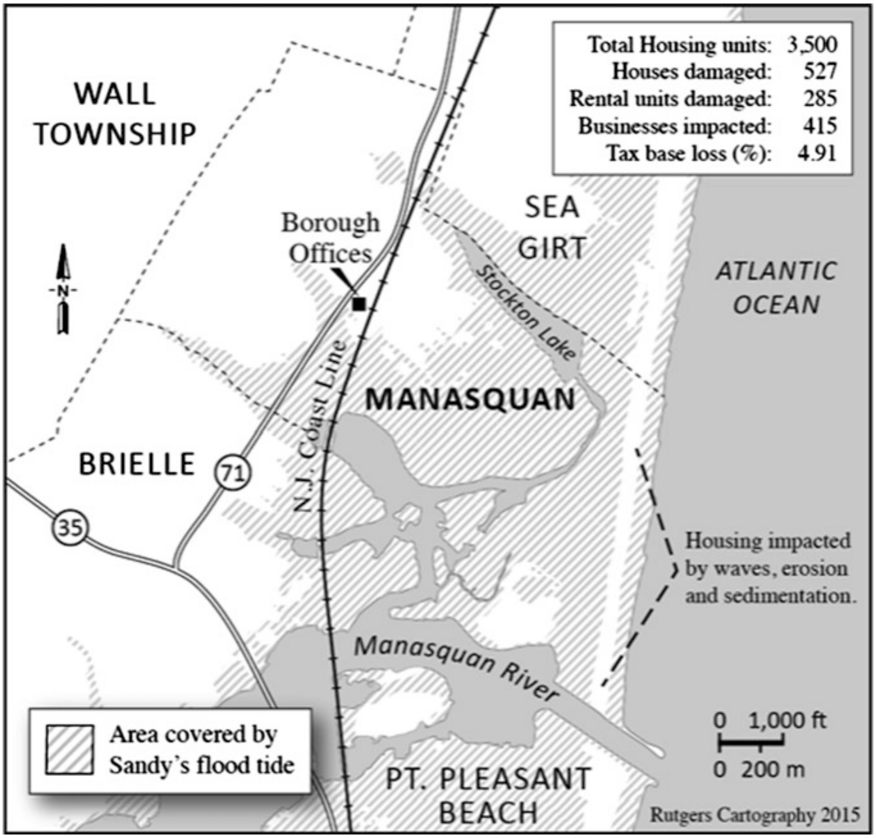

Fig. 12.2 Hurricane Sandy impacts on Manasquan, New Jersey, October 2012

> and locals perceive elevation as an open-ended variable, permitting continuous vertical adjustments by raising structures progressively higher as inundation risks increase. By comparison, risk zones on FIRMs (Flood Insurance Rate Maps) are viewed as imposing fixed (in/out, horizontal) limits on adjustment.

Further analysis of the texts of interviews and discussions shows that the term "infrastructure" is not widely understood by residents and is subject to a variety of interpretations, many of which fall outside the definitions generally employed by professionals. For example, though many adopt the (traditional) view that equates infrastructure with "hard" engineered systems (e.g., transportation and utility networks), a substantial number also includes "green infrastructure" (e.g., maintained or managed sand dunes), together with tourism-related public facilities such as boardwalks and public restrooms, and privately owned recreation service facilities such as restaurants and marinas. In other words, the implicit definition of infrastructure refers to any collectively provided service that is viewed as necessary for the community to remain secure and healthy as well as supplied with the physical

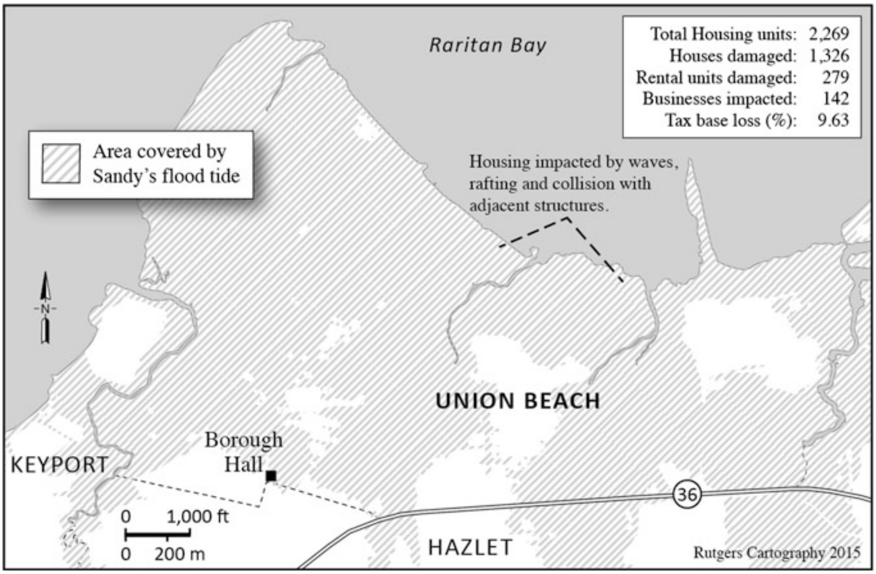

Fig. 12.3 Hurricane Sandy impacts on Union Beach, New Jersey, October 2012

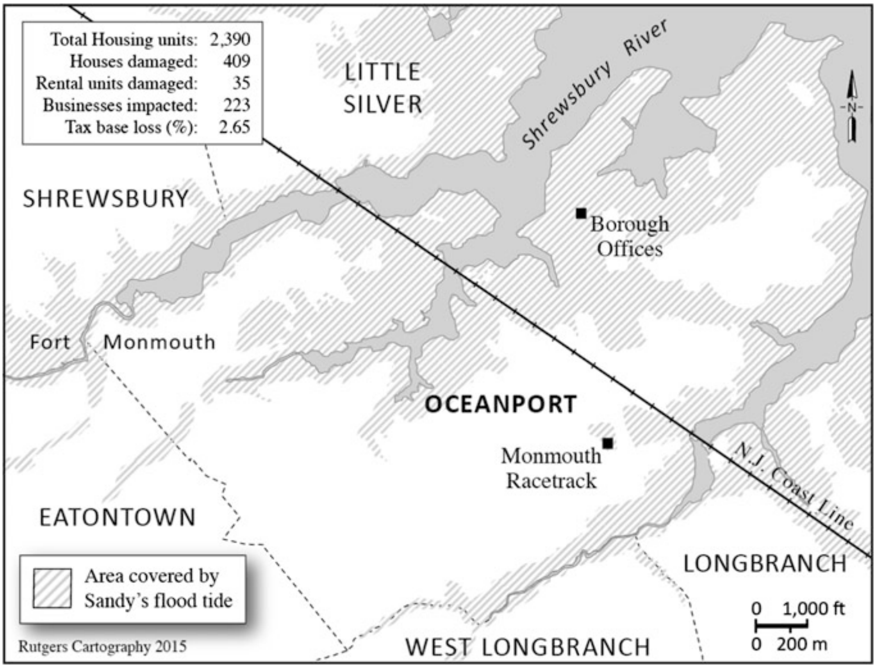

Fig. 12.4 Hurricane Sandy impacts on Oceanport, New Jersey, October 2012

resources that permit it to function. From this perspective, failures of environmental, tourism, and recreational support systems are failures of infrastructures.

Local leaders are more likely to be knowledgeable about infrastructure matters than are other local residents. The term infrastructure appears much more frequently in the interviews with local leaders than it does in focus group discussions among residents[4] (Table 12.2). Residents and local officials also focus on different types of infrastructure. The examples of infrastructure most commonly mentioned among focus groups of residents were electricity systems, followed by telephones, cooking and heating systems, and roads and streets (Table 12.2a). Among local officials, the most commonly mentioned examples of infrastructure were roads and streets, followed by garbage and debris removable systems, telephones, and electricity systems (Table 12.2b).

To a significant degree, the leaders' priorities reflect the legal responsibilities of municipal governments. In New Jersey, local leaders are acutely conscious of their statutory responsibilities for maintaining roads and streets; even the smallest municipalities usually possess a Public Works Department that executes this task. Although garbage collection and disposal is typically contracted out to private firms, municipalities still retain overall responsibility for those services. On the other hand, telephones and electricity are much more completely in the hands of private companies, overseen by state regulatory bodies like the New Jersey Board of Public Utilities. Yet it is the electrical and communications services that feature most often in resident's stories about infrastructure issues during and after disasters. Perhaps this should not be surprising since loss of electronic services not only turns off lights and appliances but inhibits igniting furnaces, boilers, and stoves for heating, cooking, and cleaning or pumping water, gasoline, and other fuels or wastes. It also deprives users of essential public news and information about their communities as well as their private social support networks. Finally, there is evidence that among laypersons the conceptual boundaries between human-made infrastructures and natural or quasi-natural systems are fading. Residents and local leaders now view dunes as elements of infrastructure though other protective structures (e.g., seawalls, bulkheads) are referenced far less frequently. This demonstrates that among both leaders and laypersons in communities at risk to coastal flooding the integrity of natural (or managed) sand dunes is perceived to be as worthy of protecting as are other infrastructures that provide safety-related services.

It is important not to overstate the salience of infrastructure problems for disaster-affected individuals and families. They were but one among many hurdles faced by storm survivors in the months following Sandy, and perhaps not the most troubling. Residents reported almost 40 different kinds of uncertainties that

[4]Ten local leaders mentioned infrastructure 211 times in open discussions of the experience of Sandy, whereas 45 focus group members mentioned infrastructure 152 times.

Table 12.2 **a** Frequency of infrastructure mentions in focus groups of residents ($N = 45$), **b** Frequency of infrastructure mentions in interviews with local leaders ($N = 10$)

(a)

	Electricity	Telephones	Gas (heat)	Roads	Others
Manasquan	9	7	9	7	7
Oceanport	13	8	1	1	4
Union Beach	25	6	1	3	8
	29%	21%	15%	13%	22%

(b)

	Roads	Garbage/debris	Telephones	Electricity	Others
Manasquan	25	8	1	10	8
Oceanport	5	3	9	0	6
Union Beach	32	13	8	4	6
	45%	17%	13%	10%	15%

Also mentioned Dunes (35); seawalls and floodgates (8)
Also mentioned Dunes (73)—frequently referred to as "green infrastructure"

constrained their decisions about post-storm recovery (Table 12.3). Infrastructure issues were conspicuous by their paucity.[5] This does not mean they were unimportant to lay residents during the recovery period, merely that other matters took precedence, mostly having to do with the physical and economic security of homes, the stability of the regulatory regime, and the physical and social contexts of the community in which the resident lived. It may be that, beset as they are by some other calls on their attention, residents are content to leave many of the decisions about infrastructure in the hands of community leaders and external experts. Such a conclusion might underline the continuing importance of experts in infrastructure recovery decision-making, but it also strengthens the case for making better use of local knowledge to create co-produced guidelines for post-storm redevelopment.

In summary, evidence suggests that local knowledge about storm risks, and about uncertainties that create barriers to post-disaster recovery, may diverge from expert knowledge. It is also clear that, during the process of recovery, the nature and roles of infrastructure may not be interpreted in the same way or accorded similar significance by lay residents, local leaders, and experts in disaster management institutions. The implications of such differences for efforts to achieve greater resilience are difficult to measure, but the possibility that they are significant should alert management interest groups to the need for clarification. This raises the question of how best to gather the kind of information that would provide optimal clarification.

[5]Uncertainties about infrastructures are clearly implicit in items # 5, 33, 36 but may also be associated with others.

Table 12.3 Uncertainties about recovery identified by focus groups

#	Class	Topic	Typical questions
1	Environment	Landforms	How will (creeks, dunes, beaches, channels, etc.) change?
2		Weather	How will storms (magnitudes, frequencies) change?
3		Sea level	Will sea level rise; at what rate?
4	Hidden risks	Mold	Will mold persist and damage health or destroy property?
5		Fire	Will soaked but not replaced electrical wires ignite?
6		Debris	Will beach users step on nails, glass, metal, or storm debris?
7	Costs/finances	Property value	What is my home worth since the storm?
8			What will it cost to repair/rebuild?
9			Will there be a market for my house?
10		Insurance	How much will insurance reimburse?
11			How long before the funds will be available?
12			Will banks and mortgage companies block use of funds?
13			Will insurance be available in the future?
14			What will future insurance cost?
15		Other aid	Eligibility for SBA (Small Business Administration) loans?
16			Eligibility for ICC (Increased Cost of Compliance) grants?
17			Eligibility for HMGP (Hazard Mitigation Grant Program)?
18			Will town get CDBGs (Community Dev. Block Grants)?
19			Will local taxes be substantially increased?
20	Replacement	Accommodation	Purchase or rent?
21			Same location as original home?
22			Smaller house?
23			Stick-built/prefabricated/modular construction?
24			Availability of alternative accommodations?
25	Regulations	NFIP-related	How high will my home have to be raised?
26			Will Advisory Base Flood Elevations become permanent?
27			Will interim Flood Insurance Rate Maps change?
28			What are LOMAs (Letter of Map Amendment)?
29			When are the cutoff dates for compliance?
30			Will recent NFIP changes be legally binding?

(continued)

Table 12.3 (continued)

#	Class	Topic	Typical questions
31	Social impacts	Demography	Will (neighbors, elderly, vulnerable) move away?
32			Will elderly (and others) be able to access elevated homes?
33		Services	How soon will schools and other services return to normal?
34		Aesthetics	Will the town's appearance change unacceptably?
35		Ambiance	Will the town regain its congeniality?
36	Other	Mitigation	Will public protective works be installed?
37			Will there be an accessible record of past and current risks?
38			Will risk information (delays, conflicts, flaws) improve?
39			How long will present turmoil last?

12.6 Better Local Information for Recovery Decision-Making: Co-production of Knowledge and Action

In institutions of democratic governance, it is broadly accepted that the most successful public policies are those that attract widespread public participation. This is no less true for hazard and disaster management institutions, including those charged with responsibilities for recovery. (Handmer and Dovers 2013; Pearce 2003) Possible forms of participation range from the perfunctory to the profound, from those that involve passive acceptance by publics that are merely kept informed about the actions of executive decision-makers to those that require continuous partnerships among various kinds of stakeholders and result in knowledge that is a joint product of experts and laypeople (Ostrom 1996; Jasanoff 2004; Wood et al. 2012; Homsy and Warner 2013; Wamsler 2016). Perhaps the most sought after of all are partnerships that solicit and employ the vernacular knowledge of local laypersons in conjunction with the specialized knowledge of professionals at all stages of decision-making from project initiation to completion and even thereafter in the form of continuous post-action assessment and monitoring programs.

Collecting local knowledge, opinions, attitudes, expectations, and preferences about disaster recovery measures, and feeding them into, the existing public policy apparatus (or designing modified alternatives) is a major undertaking at the best of times. It is even more problematic in the time-pressured and conflicted circumstances that attend disasters. At such times, conventional methods for collecting such information may also be difficult to execute because personnel and records have been damaged, victims are displaced from their homes, people are preoccupied with what they perceive as more expedient matters, and there are strong convictions in favor of a speedy return to the *status quo ante* (i.e., "normal"). Recently, a range of new decision-support tools has sprung up to assist decision-making, mostly during the immediate post-disaster *emergency* stage of disasters. Among others, these include remotely sensed imagery of disaster-affected communities and "crowd-sourced" information about the rapid assessment of damage and needs for assistance (Gao et al 2011; McCormick 2016; Haworth et al. 2016). There are also a growing number of predisaster tools for measuring and mapping risks and vulnerabilities with a view to improving disaster *preparedness and mitigation*. Some of these also depend on co-produced information (Cinderby and Forrester 2016). However, thus far, there has not been a reliable vehicle for systematically collecting and assessing local views about *recovery* alternatives and for employing this information expeditiously in support of post-disaster rebuilding and redevelopment policy decisions. Health Impact Assessments are promising candidates for that role.

12.7 Health Impact Assessment

12.7.1 Evolution and Status

As noted above, Health Impact Assessment is first and foremost a decision-support tool. But HIAs go further than assessment; they are also intended to encourage the adoption of alternatives that reduce existing health inequities and foster better health outcomes for entire communities as well as individuals. The HIA process is, in effect, a process of community engagement, usually voluntary, that involves expert and lay stakeholders in a collaborative exchange of their knowledge, concerns, and expectations and their aspirations for improved health. These objectives are sought via a systematic procedure that begins with the selection and bounding of specific decisions and concludes with evaluations of recommendations for achieving improved health objectives after the decisions are taken. Its six steps include (1) screening, (2) scoping, (3) assessment, (4) recommendations, (5) reporting, and (6) monitoring and evaluation.

HIAs were inspired by the advent of Environmental Impact Statements (EIS) required under the US National Environmental Policy Act (1970). However, the first formal ones emerged in Europe during the 1990s and it was not until the beginning of the twenty-first century that they began to appear in the USA. (Dannenberg et al 2008) Since that time, over four hundred HIAs have been completed or are ongoing in the USA. (Pew Charitable Trusts 2015) Only a handful of these have addressed issues of natural disaster explicitly, and an even smaller number—fewer than half a dozen—have been undertaken with a view to informing and aiding the process of disaster recovery. The benefits of expanding their use in support of disaster recovery are many.

HIAs that assess alternative measures for achieving improvements permit communities that are recovering from disaster to understand the long-term health and well-being implications of their choices and allow them to start down a new path toward resilience and sustainability. For example, they may adopt housing, shopping, and transportation arrangements that encourage healthy behaviors such as increased human exercise, consumption of locally grown foods, reductions in the use of hazardous materials as well as access to healthcare facilities and social support networks. In the screening and scoping phases of HIAs, local populations define the futures that they desire across a range of sectors, from safety in the face of floods and storms, and access to public facilities that enhance lifestyles, to mixes of land uses that reduce pollution burdens and expand employment opportunities that are sustainable.

To date, the emphasis in many HIAs has been on assessing the (immediate) health effects of increased risks and vulnerabilities associated with climate change and other human-forced natural hazards (Centers for Disease Control and Prevention 2014). Long-term consequences and the impacts of proposed coping measures are rarely addressed. The assumption seems to be that society already knows what to do and that the application of existing best practices of good health and hazard management will be sufficient. However, this is not necessarily so. Not only are there new kinds of risks (e.g., sea level rise), but the range and pace of technological change, the degree to which humans are reshaping the physical environment, the electronic information revolution, globalization, a broadening of the definition of health and widening economic gaps between the haves and have-nots are all calling into question the suitability of existing measures and expanding the range of choice among new alternatives. Better health is no longer a fortuitous outcome but something that can be consciously sought and achieved through effective design and societal arrangements.

12.7.2 Opportunities and Barriers for Recovery HIAs

Funded by the Robert Wood Johnson Foundation and the Pew Charitable Trusts, researchers at Rutgers University undertook an 18-month-long test (September 2014–February 2016) of the suitability of the HIA process as a means of supporting decisions about recovery from Hurricane Sandy. This included three main components: (1) a pair of case study HIAs in communities that had suffered significant losses during Sandy; (2) preparation of a municipal toolkit suitable for integrating HIA into local decision-making as part of the Sustainable Jersey certification process; and (3) an assessment of prospects for integrating HIAs into post-disaster planning and decision-making in the USA. One case study focused on the green infrastructure component of a municipal storm-water management plan for the City of Hoboken and the other on a possible buyout and clearance of flood susceptible housing in the community of Mystic Islands, in Little Egg Harbor, Ocean County. The case study communities provided data from published sources, interviews with local leaders, public meetings, focus groups, and questionnaire surveys, among others. Similar sources were tapped for the toolkit. The inquiry into mainstreaming HIAs into post-disaster planning and decision-making relied on a detailed analysis of published literature, meetings with thought leaders from academic and professional communities of specialist health, impact analysis, and hazard management. The project is reported in detail elsewhere (Mitchell 2016), and only the highlights are addressed here.

Health Impact Assessments were positively received by professionals and laypersons in the case study communities and a wide range of health, safety, and well-being-related institutions at all levels of government that participated in the research consultation process. Findings underscored the attractiveness of health as a rubric for articulating and integrating diverse interests. Health improvement was found to be a high-priority goal of local leaders and residents, despite receiving only limited attention in the US federal disaster recovery system. In other words, there exists a strong, presently unsatisfied demand for health-centered recovery support tools.

The case studies demonstrated that it was possible for disaster-affected communities to successfully execute an HIA, in support of recovery decision-making, within a period of six months after the disaster. Large amounts of valuable information about health status and outcomes were gathered and analyzed and a range of new health-centered interest groups brought into the recovery process. The salience of mental health problems and issues was particularly noteworthy. However, important gaps and barriers to adoption of disaster recovery HIAs were also uncovered. Two of these are particularly significant. First, awareness of HIAs is low, and there is a lack of communication and mutual interaction between health interest groups and disaster management ones. This calls for the removal of institutional barriers to sharing information and a broad campaign of public information and education. Second, the range of alternatives that can be considered in an HIA may be constrained by commitments made by local governments and others to secure initial approvals and funding for proposed actions. Once there is significant support for a proposed action, local leaders may be reluctant to revisit the decisions that produced agreement. This argues strongly for early introduction of HIA into the process of recovery, when initial plans are being identified and debated. Moreover, the key to successful introduction of HIAs as a decision-support tool lies in applying the results more generally at certain pivotal moments in the recovery process when appropriate avenues for employing them are opening up (e.g., Federal Rebuilding Task Forces are being organized; changes to National Flood Insurance Program regulations are being contemplated; Community Development Block Grant submissions are being prepared).

12.7.3 On the Threshold of Better Resilience

In light of accelerating global and national losses, the improvement of disaster resilience is both desirable and feasible. Compared with emergency response and preparedness alternatives, inserting resilience-promoting measures into the process of post-disaster recovery is an underutilized strategy. But the present context of disaster recovery is highly fluid because of broad societal and environmental shifts.

Many countries are developing national strategies for addressing disaster recovery as a holistic task that brings together actions that had formerly targeted separate physical, ecological, economic, and social sectors. Infrastructural initiatives loom large within these. Health Impact Assessment belongs to a set of decision-support tools that reflects the drive for holism, in this case organized around expanded definitions of health and a desire to democratize decision-making. The new definitions go beyond the notion that good health is synonymous with the absence of disease in individuals to include collective, community-wide, and area-wide dimensions. HIAs provide a vehicle for linking local citizen-driven, bottom-up decisions into national recovery strategies, and they take advantage of an emerging new division of work between experts and laypersons. When equipped with guidance about appropriate timing that enhances their nimbleness in an increasing dynamic and complex post-disaster context, they are a potentially valuable addition to the arsenal of resilience-building tools that is now emerging.

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