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Article

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Journal of Urban Management

Provided in Cooperation with:

Chinese Association of Urban Management (CAUM), Taipei

Suggested Citation: Douglas, Ellen M.; Reardon, Kenneth M.; Täger, Matthias C. (2018) : Participatory action research as a means of achieving ecological wisdom within climate change resiliency planning, Journal of Urban Management, ISSN 2226-5856, Elsevier, Amsterdam, Vol. 7, Iss. 3, pp. 152-160,
<https://doi.org/10.1016/j.jum.2018.05.003>

This Version is available at:

<https://hdl.handle.net/10419/194447>

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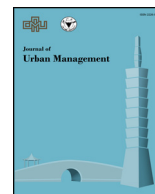
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Participatory action research as a means of achieving ecological wisdom within climate change resiliency planning

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ABSTRACT

The impacts of recent extreme weather events as well as the evidence of our changing climate has sparked a new sense of urgency in resiliency planning in the Northeast U.S. Vulnerability to climate change impacts is not limited to the built environment, but rather extends to the socio-technical systems that include the perceptions, values, preferences and patterns of behavior of various groups of human stakeholders. To more fully incorporate the human dimension into resiliency planning we must elicit and apply the ecological wisdom (EW) of local residents and stakeholders. The complexity of EW has yet to be fully described; this paper does not develop a new definition, but rather, expands the definition of EW to include local knowledge of urban dwellers that can be tapped to more effectively inform resiliency planning. We present a recent example that demonstrates how participatory action research (PAR) methods can be used to gather EW that would not ordinarily be obtained by more traditional vulnerability assessment methods. Our case study is based upon the Alewife Disaster Preparedness and Community Resiliency Planning Initiative of the City of Cambridge, Massachusetts. Despite the limited scope of this PAR project, a surprising number of useful observations and recommendations were obtained, which could serve to enhance the ongoing resiliency planning of the City of Cambridge. Local stakeholders also suggested a number of what W.F. Whyte described as “social inventions” for strengthening the quality of disaster preparedness and community resiliency within the Alewife community. We highlight the need to give more attention to the human dimension of resiliency planning by better understanding how a variety of local stakeholders’ experience climate-related disasters, perceive the effectiveness of alternative disaster preparedness and community resiliency strategies, and determine their willingness to contribute to ongoing resiliency planning taking place within their community.

Defining ecological wisdom in the context of contemporary resiliency planning

Research and discussion of the concept of ecological wisdom (EW) in landscape architecture and urban planning, which began at an international symposium in Chongqing, China, in 2014 and has been further advanced in this journal, is still nascent. As a theoretical, practical, and normative concept designed to help landscape architects and urban planners address wicked problems in socio-ecological systems, the complexity of EW is yet to be fully understood, described and disentangled. In fact, even descriptive definitions of EW published in this and other scholarly journals differ in important ways. This paper does not attempt to merge existing definitions or develop a new definition, rather, it identifies three elements of EW that appear to be both consensual and essential to its successful application to resiliency planning.

First, the various sources and types of knowledge contributing to EW are central to the concept. Manifestations of this aspect of EW highlighted in previous research are the interdisciplinarity of the planning team, the integration of theoretical insights with practical experience and/or local knowledge and the openness to understanding socio-ecological systems based upon observational, statistical, modeling and other scientific methods (Patten, 2016, p. 4 and 8; Wang, Palazzo, & Carper, 2016a; Wang, Palazzo, & Carper, 2016b, p. 102; Xiang, 2014, 2016; Yang & Li, 2016; Young, 2016, pp. 95–96). A second crucial component is contained in the

Peer review under responsibility of Zhejiang University and Chinese Association of Urban Management.

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<https://doi.org/10.1016/j.jum.2018.05.003>

Received 28 June 2017; Received in revised form 29 April 2018; Accepted 31 May 2018

Available online 24 August 2018

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goals and practice-orientation of EW, which seeks to facilitate and create real and permanent good. Although the exact phrasing varies from “enhancing human experience” (see Fu, Wang, Schock, & Stuckert, 2016, p. 80) to “advancing the quality of life” (Wang et al., 2016a, 2016b, p. 100), all conceptions of EW share the idea that some tangible improvement of socio-ecological systems needs to be achieved through practice (Xiang, 2014, 2016). The embeddedness of this goal-oriented practice into a larger normative and ontological view of human-nature relations is a third constitutive element of EW. Societies and nature are not described as separate systems exchanging goods and services but as ontologically coupled in a quasi-symbiotic relationship (Wang et al., 2016a, 2016b, p. 102). Derived from this ontology is the normative stance that a balance of both the human/social and the natural/environmental components of socio-ecological systems must be the goal and the outcome of ecologically wise practice (Young, 2016, pp. 95–96).

Accepting these three essential elements as a necessarily incomplete working definition, two limitations in the emerging field of EW research can be identified: First, very little is known or has been published to date about techniques and methods for generating or activating EW. Thus, the question posed by Xiang (2014, p. 68) “how EW can be acquired” remains unanswered. Second, both theoretical discussions and empirical case studies have almost exclusively focused on one direction of impact in socio-ecological systems: the impact of human activity, e.g. development of land, on ecosystems. However, the increasing awareness of climate change impacts on both human and natural systems requires that we consider EW’s potential for guiding resiliency planning and management to create real and sustainable good. Urban populations are increasingly disconnected from their natural environment and thus possess limited ecological knowledge (see Liao & Hui Chan, 2016, p. 113) *per se*. However, urban dwellers are aware of their local environment and the intricacies of the urban systems upon which their livelihoods depend. Therefore, this paper expands the concept of EW to include local knowledge that can be elicited to inform urban climate change adaptation and resiliency planning. We present a recent example of resiliency planning from the Greater Boston Metropolitan Area that seeks to demonstrate how one might address the previously mentioned limitations in EW research. The case study is based upon the City of Cambridge’s Alewife Disaster Preparedness and Community Resiliency Planning Initiative. This case attempts to compliment what William F. Whyte described as “professional expert” knowledge produced by university trained researchers using highly quantitative methods with “local” knowledge generated by long-time residents using a variety of qualitative research methods (Whyte, 1981). The data provided by local residents participating in this resiliency planning initiative offers new insights regarding local actors’ perceptions of climate change-related risks, levels of community awareness and confidence in official resiliency plans, resident’s current levels of disaster preparation, as well as existing gaps within municipality-sponsored emergency response plans.

The evolution of climate change-related resiliency planning in the Boston Metropolitan Area

The reality of our changing climate and the resulting impacts on human and natural systems is now unequivocal (IPCC, 2014). For coastal communities, sea level rise (SLR) is one of the most certain (Church et al. 2013; Moser et al. 2014) and potentially destructive of these impacts. Rates of sea level rise along the northeastern US coastline since the late 19th century are unprecedented (Kemp et al., 2011) and recent studies (Yin, Schlesinger, & Stouffer, 2009; Bamber, Riva, Vermeersen, & LeBrocq, 2009; Douglas, Kirshen, Hannigan, Herst, & Palardy, 2016) suggest that the northeast US could experience even greater SLR rates due to changes in ocean circulation and ice sheets. In response, coastal communities in the northeast US have been taking concerted action to assess their vulnerability to and plan for the resiliency in the face of future SLR and resulting coastal flooding. In this paper, we focus on resiliency planning efforts in the Boston Metropolitan Area (BMA), in eastern Massachusetts.

The first study in eastern Massachusetts (and possibly in the nation) to highlight climate change vulnerability and outline potential resilience was the USEPA-funded study entitled Climate’s Long-term Impacts on Metropolitan Boston (CLIMB; Kirshen, Anderson, & Ruth, 2006; Kirshen, Knee, & Ruth, 2008). CLIMB rigorously assessed the vulnerability of the Boston Metropolitan Area (BMA) to increased temperatures, intensified storm events and coastal flooding due to climate change and reported the following: a rise in sea levels of only 12 in. could increase flood risk by a minimum of 5- to 10-fold potentially causing \$94 billion in property damage and emergency response costs over the 21st century; extreme weather events could cause an 80% increase in traffic delays in Boston already ranked near the top for congestion; higher temperatures could increase human mortality and reduce water supply, quality and suitability for native fish habitats; river flooding due to increasingly extreme rain events could double the number of vulnerable properties and related damage costs. Shortly after the CLIMB study was completed, the Union of Concerned Scientists sponsored the Northeast Climate Impacts Assessment (NECIA; Frumhoff, McCarthy, Melillo, Moser, & Wuebbles, 2007). Along the entire northeast US, coastal flooding was projected to increase in both elevation and frequency. Under the highest emissions scenario evaluated, large areas of downtown Boston (including the Financial District, the Wharf Area, Government Center; Fig. 1 left) as well as several high value residential neighborhoods (Back Bay, South Boston; Fig. 1 right) could be inundated by 2100. Projected flooding of the Back Bay neighborhood was particularly troubling because it mentioned the possible failure of the New Charles River Dam, built in 1978 to protect the cities of Boston and Cambridge from tidal influxes and storm surges. In many ways and for many communities, the results of the CLIMB and the NECIA reports sparked a new sense of urgency regarding the need for additional resiliency planning and flood preparedness in eastern Massachusetts, with the City of Boston taking the lead.

Boston’s “climate revolution” began on February 3, 2010, when the Boston Climate Action Leadership Committee¹ came out with its first plan to address the impacts of climate change on the city. Later that same year, the Boston Harbor Association (TBHA, which is now known as Boston Harbor Now²) sponsored the first “Boston Sea Level Rise Forum”, which included a public lecture followed

¹ <https://www.cityofboston.gov/climate/>.

² <http://www.bostonharbornow.org/>.

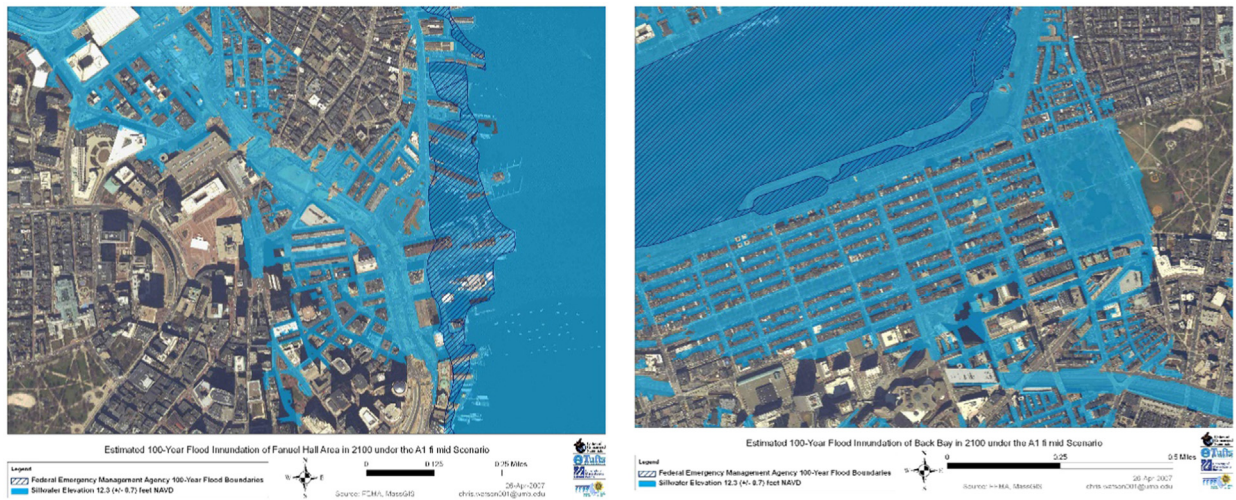


Fig. 1. Depiction of inundation in Downtown Boston (left) and Back Bay area (right) due to the 100-yr. coastal flood event by 2100. Source: Frumhoff et al., 2007.

by a day of workshops designed to spur discussion and action across sectors and agencies regarding the impact of sea level rise and coastal flooding. Boston's first Climate Action Plan was released on Earth Day 2011. Its second Climate Action Plan was released on October 29, 2013, the first anniversary of Superstorm Sandy, highlighted a widespread belief that Boston had “dodged a bullet” and needed to accelerate its disaster preparedness and resiliency planning efforts. The years 2013 through 2015 saw fifteen vulnerability assessments incorporating resiliency strategies and recommendations undertaken by local non-governmental organizations (6), municipal departments (5) and state agencies (4). State agencies tended to evaluate the impact of climate-related storm damage on specific public services for which they are responsible (e.g., water supply, storm water drainage, transportation) while city assessments tended to be broader in scope, ranging in coverage from critical infrastructure to social vulnerability. The NGO reports tended to address specific human service delivery sectors at risk such as affordable housing, urban development, and public infrastructure. Resiliency to the impacts of sea level rise and coastal storms was the focus of most of these reports, with some also incorporating flooding caused by extreme precipitation and health impacts caused by extreme heat episodes. The earlier reports focused almost entirely on physical infrastructure and assets, but by 2015, governance, human health and welfare and vulnerable populations were also included. Community engagement activities carried out as part of these later initiatives, generally used neighborhood meetings to elicit local stakeholders' responses to study findings and recommendations.

The most recent resiliency planning initiative, *Climate Ready Boston*³ released in 2016, presents a multi-sector, city-wide vulnerability assessment and recommendations for specific resiliency initiatives such as protecting coastlines, preparing communities and making infrastructure and buildings more resilient. The City of Cambridge, Massachusetts, located just across the Charles River from Boston, has also undertaken a comprehensive climate change vulnerability assessment (CCVA) and preparedness and resiliency planning (CCPR) initiative,⁴ slated for completion in 2018. The CCVA (released in 2015 and 2017) evaluated a broad range of climate impacts from urban heat island effects to storm water flooding to sea level rise and coastal flooding. The CCPR is being developed under the guidance of an inter-departmental steering committee consisting of the City's Public Works, Public Health, and Community Development Departments. The social vulnerability analyses undertaken by all of the aforementioned resiliency planning efforts has been almost exclusively executed using geospatial datasets and indicators and complex climate and hydrological modeling software, with minimal direct participation of local stakeholders. By doing so, Cambridge's early resiliency planning efforts have not fully benefited from the EW possessed by stakeholders most likely to be directly affected by such events. This paper highlights an example of how local officials responsible for disaster preparedness and community resiliency planning in Cambridge are beginning to use participatory action research methods to incorporate local stakeholders' EW to enhance the quality of their climate adaptation and resiliency planning efforts.

The intersection of ecological wisdom and participatory action research

Participatory Action Research (PAR) is a mode of research in which stakeholders who are often excluded from the design and conduct of traditional research are integrated into each and every step of the research process (Whyte, Greenwood, & Lazes, 1991, pp. 21–22). This means that the research process and design is constantly being shaped by the values, knowledge and perspectives of local actors who help guide the direction and modes of research practice, overcoming the limitations of disciplinary and often-

³ <https://www.boston.gov/departments/environment/climate-ready-boston>.

⁴ <http://www.cambridgema.gov/cdd/projects/climate/climatechangeresilianceandadaptation.aspx>.

compartmentalized approaches to research creating a more holistic perspective on the issues being investigated (Whyte et al., 1991, pp. 40–42). In addition, PAR is mission-driven in the sense that its primary goal is to bring about positive social change within the organization or system under observation (Vallenga, Grypdonck, Hoogwerf, & Tan, 2009, pp. 81 and 84–85). Its ethical base is also guided by its emancipatory aspiration of democratizing both access to knowledge and knowledge production – again to challenge the status quo maintained by closed systems of knowledge production controlled by university-trained experts (see Gaventa, 1993; Greenwood & Levin, 1998, pp. 4–8).

From this very brief and rudimentary description of PAR it becomes clear that there are multiple points where PAR and EW intersect. First, the idea of mobilizing and integrating multiple perspectives, different bodies of knowledge and unique types of expertise unifies them in an obvious way – while EW formulates it as an aspiration, PAR provides a set of concrete research strategies for achieving this goal. Second, both PAR and EW are action-oriented demanding that research and knowledge generate findings and recommendation that lead to positive change, especially for those marginalized groups whose interests are often undervalued or misinterpreted within traditional positivist-oriented social science research projects. Third, connected to this second point is the acknowledged relevance of norms and values for practice. Both EW and PAR provide planners with a basis for allowing values to guide practice. Many authors of EW research explicitly profess two basic tenets of PAR: the integration of diverse values of affected stakeholders into the research and planning process at an early stage (see Patten, 2016, p. 8) and the integration of stakeholders' perceptions throughout the research process (see Wang et al., 2016a, 2016b, p. 102).

Overview of the City of Cambridge Alewife resiliency plan

Reviewing the results of the first phase of the City of Cambridge's Community Vulnerability Assessment (CCVA), municipal planners and city officials realized they needed to take immediate steps to protect their rapidly developing Alewife District from the most-likely climate-change related threats. This area emerged as a top priority for immediate-term climate action planning because of the: density of critical infrastructure investments within the area, presence of the City of Boston and Cambridge's major evaluation route transecting the district, the high percentage of vulnerable individuals and families living in the neighborhood, and the rapid pace of high density/mixed use development taking place. The City responded to these factors by contracting with Kleinfelder, an internationally recognized leader in resiliency planning, whose management entered into subcontracts with eight energy, environment, housing, transportation, and urban planning consultants to formulate a comprehensive disaster preparedness and community resiliency plan for this 370-acre district. Among the entities invited to participate in this effort was the University of Massachusetts Boston's School for the Environment (SFE) whose researchers were asked to elicit local knowledge possessed by Alewife's poor and working-class families and service providers regarding the current state of the city's disaster preparedness and community resilience programs and systems. (Tables 1–3).

The team that designed and conducted this research was comprised of selected students and faculty from the SFE representing a diverse set of disciplines and professional backgrounds as recommended by the EW literature. Among the team members were a community development practitioner, a hydrologist, a land use expert, a political scientist, and an urban planner. The research design as well as the choice of methods were strongly influenced by the organizational embeddedness in the City of Cambridge's Alewife pilot project. Three circumstances were of specific significance: a) the relative late stage at which the research team was invited to join the Alewife pilot project, b) the fact that the authors were contracted by the City which defined the project's deliverables, i.e. the goals of the research to be conducted, and c) the results of the technical vulnerability assessments already conducted by the City and

Table 1
Alewife residents affected by extreme weather events.

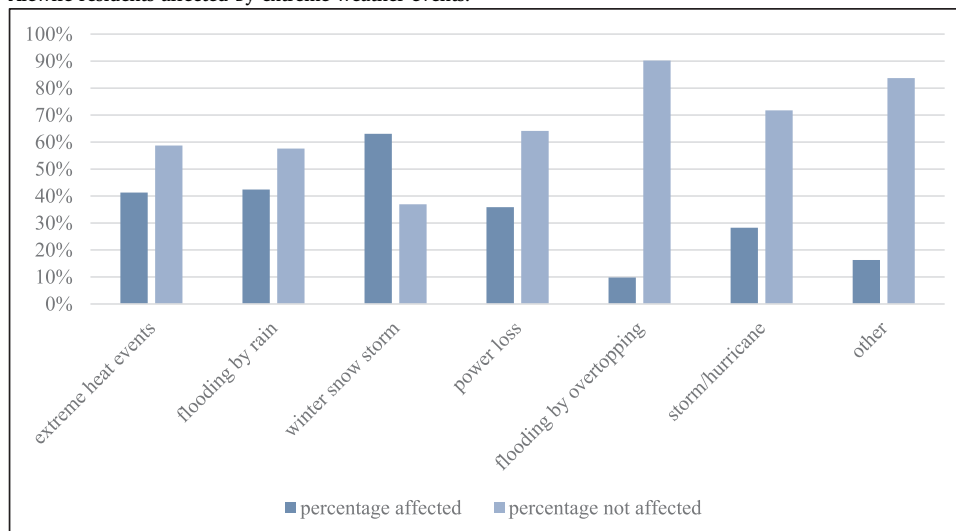
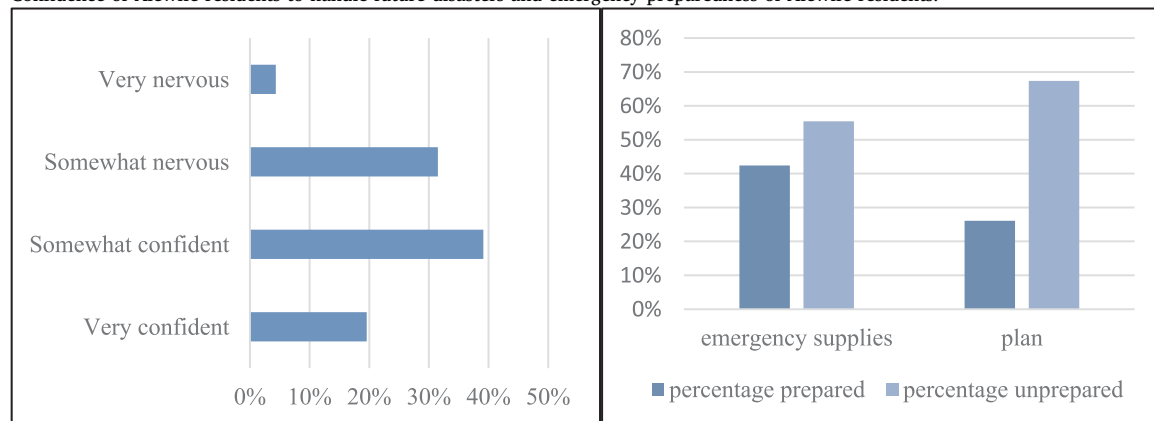
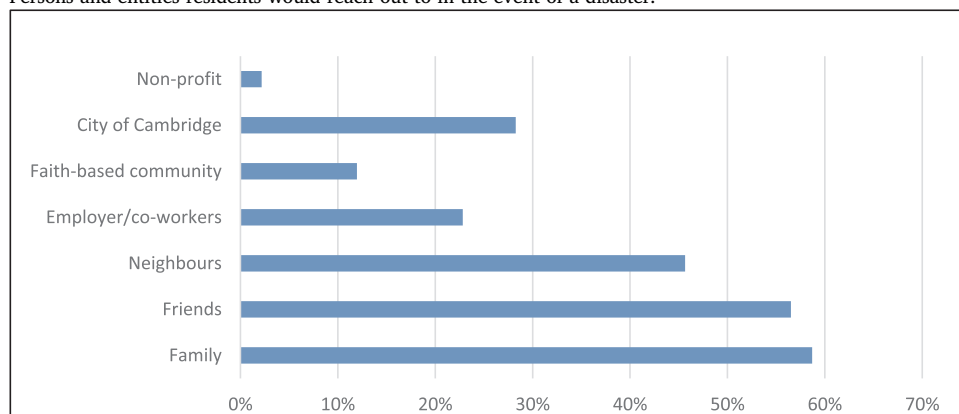


Table 2

Confidence of Alewife residents to handle future disasters and emergency preparedness of Alewife residents.

**Table 3**

Persons and entities residents would reach out to in the event of a disaster.



Kleinfelder. While these circumstances influenced the project's depth and breadth, the latter two circumstances shaped the design of the research instruments in ways described below. Research questions, the scope of the project, and the specific research methods were developed and agreed upon during multiple meetings and workshops attended by the authors and representatives of the City of Cambridge, Kleinfelder, and the project's other consultants. Despite these contextual constraints, the authors were guided in their practice by the key PAR principles and techniques previously discussed.

Research questions

The following three conceptually separate but logically linked research questions were cooperatively developed by the City, Kleinfelder and the SFE: What do Alewife stakeholders perceive to be the greatest climate disaster-related threat facing their community? How confident are Alewife stakeholders in their ability to manage the health and welfare needs of their households and/or workforce considering this and other natural disaster threats? What are the single most important steps the City of Cambridge, in collaboration with local service providers, can take to enhance local stakeholders' overall disaster preparedness? In addition to those three questions, an overarching focus on the experience and perceptions of the area's most vulnerable populations, as defined in the previous vulnerability assessments, was a critical value guiding the research.

Methods

The research design which the SFE Alewife Research Team formulated included a literature review focusing on best practices in climate-related disaster preparedness in US cities and three methods of field-based data collection. The first field-based research method consisted of individual interviews with leaders of community-based organizations serving vulnerable segments of the Alewife population such as the poor or the elderly. These so-called institutional interviews were designed as semi-structured interviews with open-ended questions focused on the five most likely climate-related disaster scenarios for Alewife based upon the recently completed vulnerability assessments. The method of targeted institutional interviews revealed a clear overrepresentation of women in civil

society and administrative positions concerned with citizens' climate-related resilience. While the scope of this research did not allow the authors to further explore and analyze the causes and implications of this overrepresentation, it should be flagged for two reasons: First, this overrepresentation could introduce a gender-bias into the data gathered. Second, it shows the necessity to be sensitive to gender-related questions. Generally, in decision-making structures dominated by men EW carried by women might be less likely to be incorporated into resilience planning. The second data collection method were interceptor interviews (a.k.a. man/women on the street interviews) during which SFE researchers asked men and women they encountered near the neighborhood's heavily-used public transit station questions regarding their perceptions of local climate change-related disaster threats and city-supported emergency response and recovery programs. These so-called interceptor interviews followed a fully-structured format featuring a majority of close-ended questions, in part, to guarantee the completion of the interviews within three to five minutes. The goal of both the institutional and interceptor interviews was to integrate multiple perspectives and different types of local and experience-based knowledge into the research process. The third method, focus groups, was added when interviewees suggested other sources of local knowledge pertinent to this research. Focus groups were held with members of a local business association and a civic group. The addition of focus groups to the methodology exemplifies both the strength of and the necessity for flexible research designs open to change based upon newly emerging field-based knowledge and insights as advocated by both PAR and EW. Without this flexibility valuable knowledge would have been lost for the research and planning process. In the end, data was collected during six institutional interviews, 92 interceptor surveys, and two focus groups involving approximately twenty individuals.

Data collection and analysis

The process used to collect and analyze the data collected through the focus groups and institutional interviews was identical. The two interviewers summarized the content of the group forums and interviews separately extracting all of the information, concerns, perceptions and ideas voiced that were related to the three-main research questions mentioned above using field notes and audio recording produced during these activities.⁵ In a second step, these separate summaries were shared, compared and merged after discrepancies were identified and resolved. The content of the interceptor interviews was analyzed based on the question type. Open-ended questions were coded in an open coding process aiming at identifying patterns and combining similar answers without limiting the wide range of answers given. Thus, depending on the question, up to fourteen response categories were identified, which were in some instances further split into to eight subcategories. Answers to close-ended questions were counted and presented as basic descriptive statistics. In a final step, results from institutional interviews, focus groups and interceptor interviews were organized into a SWOT (Strengths, Weaknesses, Opportunities, Threats) Analysis. This is a common data analysis approach used in urban planning to summarize complex data sets pioneered by Stanford Research International and popularized by the Harvard Business School (Humphreys, 2005).

Limitations of this research

In general, obvious limitations of this research design included the relatively modest number of interviews conducted and the resulting underrepresentation of certain stakeholders and perspectives from the research and planning process, such as youth and the homeless. From a PAR perspective, it must also be noted that those most affected by this research were not involved in either drafting the research questions nor collecting and analyzing the resulting data due to the contractual constraints described above. Although the design was inspired by PAR principles, this design was, by necessity, more focused on gathering information than on advancing social change through the building of local organizational capacity- (see Vallenga et al., 2009, pp. 82–84). It must also be noted that the authors had little direct influence over the integration of the results into the actual Alewife plan-making process.

Research findings

Despite these limitations, a number of noteworthy research findings and policy recommendations regarding disaster preparedness and community resiliency planning in Cambridge emerged from the field-based research activities carried out for "The Local Perceptions of Disaster Preparedness in the Alewife District of Cambridge, MA Report" prepared for the City of Cambridge's Community Development Department. Among these findings were:

Widespread appreciation of the City's effort to elicit stakeholders' perceptions of local climate threats and strategies for improving overall disaster preparedness at the beginning of the planning process. Local institutional representatives, community leaders, and area residents described the City's historic pattern of consulting local stakeholders near the end of public planning processes when it was often too late to influence the goals, objectives, policies, and programs contained within these documents. Under Cambridge's recent City Manager, local stakeholders began to be consulted on major development projects and community plans much earlier in the process. Local stakeholders cited recent development projects, budget items, and zoning decisions that had been positively impacted by resident preferences. Nearly every individual contacted by the SFE researchers during the Alewife planning process stated how pleased they were by the City's effort to draw upon the "local knowledge" of residents, institutional leaders, and service providers at the beginning of its current resiliency planning efforts.

⁵ Two interviews were conducted by only one of the authors eliminating the two-step procedure and leaving it to one researcher alone to summarize the content of the interview.

The limited scope of the initial list of groups the City's consultants had identified as vulnerable during likely future climate change-related disasters. Subcontractors working with the City's primary CCPR consultants had identified low-income households, public housing tenants, senior citizens, persons with disabilities, and new immigrants from non-English speaking countries as vulnerable groups whose needs the City should devote special attention to during their ongoing resiliency planning efforts. Many of the stakeholders contacted by the SFE researchers felt this list was incomplete pointing out that more low-income families now live in subsidized housing units outside of traditional public housing complexes. They described how the City Council had sought to combat the City's growing affordable housing "crisis" by requiring 12–18% of the units in newly constructed residential buildings to be affordable to the poor. While low-income families living in public housing complexes benefit from on-site (24 h) property management and case management staff who can assist them before, during, and after serious climate change-related disasters, the poor living in affordable housing units within these newly constructed market rate buildings typically do not have access to similar staff assistance. Stakeholders also pointed out how busing, instituted in the mid-1970s to achieve school integration and educational equity, required the majority of the City's school-age children to be transported from their neighborhoods often to distant schools. Stakeholders described the risks these students would face in the event of an unexpected, but serious storm event, that might prevent them from returning to their homes.

Uneven preparation for future climate-related disasters by the City's frontline agencies and municipally funded non-profit organizations. While the majority of stakeholders we interviewed were very aware of the City's efforts to engage senior administrators from their uniform services and key non-profit partners in serious disaster preparedness and community resiliency planning, they pointed out the limited extent to which these plans have been disseminated, discussed and institutionalized within the various levels of these organizations. For example, while the City's Senior Citizens Centers' have clear policies, procedures, training, equipment, and staffing to address prolonged "heat crisis", this network has not developed similar protocols to address other expected climate-change related threats such as heavy precipitation, severe snowfalls, overtopping of the Mystic and Charles Rivers, or unexpected tropical storms. While senior executives from the City's municipal agencies have crafted thoughtful disaster plans, middle level managers and lower level supervisors responsible for overseeing key facilities and implementing disaster preparedness protocols indicated they were not familiar with the details of such plans, somewhat unsure of their organization's disaster-related policies and procedures, and not completely confident of the location of disaster-related equipment such as: emergency generators, flash lights, first aid equipment, and bedding. They also stated that they had not received specialized disaster planning, management, and recovery training and/or been evaluated and rewarded on the basis of their knowledge of such policies and procedures.

Municipal government's limited effort to mobilize the City's extensive network of faith-based institutions, community-based organizations, and businesses to compliment municipal government's disaster preparedness and community resiliency planning. Many local stakeholders were disappointed by the City's modest efforts to engage Cambridge's rich network of community-based organizations in identifying, educating, and supporting individuals and families that might be at risk during climate-related disasters to ensure they receive the supplemental services they may require. Many respondents felt these networks could be more effectively used to disseminate information regarding existing climate-related disaster risks, essential emergency equipment needed at home/school/and work, local evacuation routes, steps households can take to effectively manage these situations, as well as the best sources of timely information regarding local emergency services especially those offering transportation and temporary shelter.

Local stakeholders have great confidence in the City's capacity to prepare for, manage, and recover from expected climate-change related disasters. Most stakeholders were highly confident in their local government's ability to handle the most important environmental, economic, and social impacts of a major climate-change related disaster. They believed Cambridge's location, infrastructure system, institutional assets (i.e. municipal government, world-renowned universities and medical centers, high tech businesses), and well-educated and resourceful population will enable it to manage the most likely short- and medium-term climate-change related disasters. While most had never visited the City's webpage to investigate its disaster preparedness and community resiliency resources and "real time" weather and threat assessment features – they assumed that a City "like Cambridge" would have little trouble providing this information to its residents and businesses. When asked to consider what they might do in the event a serious disaster disabled local internet and cable service, many respondents admitted they had given little thought to being without such services and/or basic electrical power.

Residents who acknowledged being either somewhat and/or very concerned regarding their household's ability to manage future climate-change related disasters had, ironically, done little to prepare for such possibilities. While many of our interview and survey respondents admitted being somewhat and/or very concerned about their household's ability to manage a serious climate threat in the future, surprisingly few of these individuals had taken concrete steps to prepare themselves and/or their families for such a possibility. Approximately half of those we interviewed had assembled emergency kits, identified preferred and alternate evacuation routes, located the nearest emergency services centers and temporary housing sites, or visited the City's webpage to see where disaster-related emergency information was available to the public.

Cambridge's primary evacuation route is frequently congested prompting many residents to ask the City to explore possible alternative routes. Stakeholders' experience with traffic congestion on evacuation routes, such as the Alewife Parkway, was at odds with local officials' most recent traffic assessments. While the City had interpreted an observed reduction in traffic counts as an indication that traffic flow had improved along its primary evacuation route, local residents suggested the lower traffic counts were caused by grid lock conditions on this street. In light of this reality, they want to City to explore a variety of alternatives, including the use of secondary streets as alternatives, the conversion of walking and biking paths and bridges to auto use during emergencies, and possible water born solutions.

West Cambridge's current development patterns featuring high density retail, commercial, and residential uses with few public spaces and third places impedes the formation of social capital critically needed during periods of natural and man-made disasters. Newly developed

areas of West Cambridge feature first-floor retail and commercial development and upper-level “market level” housing. Currently, little space is set aside for neighborhood playgrounds, parks, social institutions, and informal community gathering spots. The majority of new housing being built feature one and two-bedroom apartments serving the needs of young couples, without children, who are working at Cambridge’s colleges and universities, high-technology, and bio-engineering sectors. When these couples have children they often relocate to nearby suburbs known for their bucolic surroundings, excellent playgrounds and parks, and outstanding schools. This lack of “common spaces” essential to encouraging interaction among residents and “life cycle” housing which often leads to short-term residency discourages the development of solidarity and social capital needed to facilitate mutual self-help during disasters. The disaster literature (e.g., Olshansky, Hopkins, & Johnson, 2012) repeatedly points out how informal social networks and community-based organizations are typically the “first responders” rather than local and/or provincial government following major disasters. Many stakeholders believe West Cambridge’s dominant development pattern has had a chilling effect on the ability of the residents and workers within its newly developed areas to respond to expected future disasters.

There are a number of non-profit organizations in the Alewife District that have been early and effective adopters of “best practices” in resiliency planning that can serve as models for other local institutions. For example, a local non-profit housing provider has worked with representatives of Enterprise Community Partners, a highly regarded national intermediary, to apply resiliency standards to their building designs and operations. They are currently working with this national group to integrate basic disaster preparedness, management, and recovery planning into their staff training and resident orientation programs. This organization, and their national intermediary, could play an instrumental role in helping other non- and for-profit housing developers adopt best practices in resiliency-based building construction and management.

Resiliency planning recommendations based on ecological wisdom

Despite the limited scope of this PAR project, a number of important new preparedness and resiliency observations, suggestions and recommendations were obtained by eliciting the EW of local Alewife stakeholders, which could significantly enhance Cambridge’s ongoing CCPR efforts. Local stakeholders who contributed to the Local Perceptions Report (Reardon, Wiggins, & Tager, 2017) also identified a number of what W.F. Whyte described as “social inventions” for strengthening the level of disaster preparedness and community resiliency within the Alewife community (Whyte, 1981). Among the most compelling of these recommendations were the following.

1. The City should consider expanding its list of vulnerable populations to include poor and working-class families living in “assisted housing units” outside traditional public housing complexes as well as children being bused outside of their neighborhoods to achieve school desegregation and education equity.
2. The City should consider undertaking a systematic effort to mobilize Cambridge’s extensive non-profit network to identify, educate, and provide supportive services to low-income families who will need additional services before, during, and after climate-change related disasters.
3. The City should consider making full funding of departmental budgets contingent on the degree to which these agencies develop detailed preparedness and resiliency plans, formulate policies and procedures to insure their implementation, orient and train staff at all levels of their respective units to provide leadership during disasters, engage in multi-agency disaster simulations to insure the seamless implementation of such plans, and evaluate and key disaster planning-related staff on their knowledge of their agency’s plans, policies, procedures, and equipment.
4. The City should consider engaging the small number of property management firms who operate the majority of its recently constructed mixed-use buildings in West Cambridge to ensure they have disaster preparedness and management plans, procedures, and equipment.
5. The City should consider modifying its current approach to Alewife zoning by embracing key elements of traditional neighborhood design (Barnett, 2003) which features a commitment to public open spaces, third places, and “life cycle” housing which have shown to promote resident solidarity and social capital formation essential to supporting the disaster preparedness and resiliency efforts of informal networks and community-based institutions – the traditional “first responders” during times of disaster.

Local stakeholder voice in future cambridge resiliency planning efforts

The many thoughtful observations regarding the current state of disaster preparedness in Cambridge and how it could be further enhanced made by local stakeholders during the Alewife planning process impressed the Director of the City’s Community Development Department. This individual took quick action to distribute the “preliminary draft” of the *Local Perceptions Report* (Reardon et al., 2017) to his colleagues to make sure the emerging City-Wide Disaster Preparedness and Community Resiliency Plan addressed the report’s major findings and recommendations. Positive feedback received from managers of the City’s public works, health, and housing agencies prompted the Director of the Community Development Department to subsequently publish the entire report on the City’s website even though it contained a number of criticisms of the City’s past and current disaster preparedness and community resiliency planning.

Other SFE researchers preparing a climate action plan for East Boston who were aware of the many insightful observations and constructive recommendations obtained from stakeholders during the Alewife Pilot Study subsequently adopted several of the qualitative research methods used in this study to elicit EW in their community. However, they have had to prevail upon students and faculty participating in a Planning Studio at the Graduate School of Design at Harvard to complete this work. In order to more fully

incorporate the EW of local stakeholders into the quickly expanding field of resiliency planning, public and private funders of these efforts must accept that climate change vulnerability is not limited to natural features and man-made structures that can be made more resilient through technical solutions. Rather, such vulnerability extends to the sociotechnical systems that include the natural environment, man-made structures, as well as the perceptions, values, preferences and patterns of behavior of various groups of human beings. We need to give significantly more attention to the human dimension of resiliency planning by better understanding how a variety of local stakeholders understand their relationship towards nature, assess possible climate-related disasters, perceive the effectiveness of alternative disaster preparedness and community resiliency efforts, and determine their willingness to contribute to resiliency planning efforts taking place within their community. Just as early urban housing and neighborhood revitalization efforts failed because policy-makers viewed them as “brick and mortar” initiatives, early resiliency planning efforts will be less successful than we desire if we fail to tap the EW and community-building commitment of local stakeholders who are most likely to suffer as a result of climate-change related disasters. This will require the professionals leading our current resiliency planning efforts (i.e. architects, engineers, and planners) to realize the limits of what Whyte and others called “professional-expert knowledge” and the potential contributions of what Clifford Geertz called “local knowledge” to future resiliency planning efforts (Geertz, 1983). This paper demonstrates how PAR can be a valuable tool in gathering and integrating these two types of knowledge in order to generate useful forms of EW.

Acknowledgements

This research was funded in part by the City of Cambridge, Massachusetts, as part of a comprehensive climate change preparedness and resiliency planning (CCPR) initiative. The CCPR is being developed under the guidance of an inter-departmental steering committee consisting of the City’s Public Works, Public Health, and Community Development Departments. Funding for this research was also provided by the School for the Environment in the University of Massachusetts Boston.

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