Applied Geography 99 (2018) 63–76

Contents lists available at ScienceDirect

Applied Geography

journal homepage: www.elsevier.com/locate/apgeog

Ground truthing spatial disaster recovery metrics with participatory mapping in post-Katrina Mississippi

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ARTICLE INFO

Keywords:
Disaster recovery
Spatial indicators
Volunteered geographic information (VGI)
Critical GIS
Environmental perception
Mixed methods

ABSTRACT

Quantitative approximations of community-level recovery are a mainstay in disaster science. These longitudinal spatial metrics, which chart the status of housing stock, economic indices, or demographic change post-disaster, aim to make the complex recovery process more understandable. The question remains, however, whether these technical approaches often imposed by outside researchers draw the same conclusions about recovery as do assessments made by community insiders who have lived through the process. To address this question, this study uses participatory mapping as a means to ground truth spatial disaster recovery metrics compiled from secondary data sources. Techniques for collecting, aggregating, and transforming qualitatively mapped data are detailed. Clustering techniques to ready longitudinal recovery metrics for comparison with the participant-derived data are also described. Acknowledging that the best recovery measurements, whether qualitative or quantitative, should validate one another, this paper contributes to geographical scholarship on disasters by providing a method for conducting such cross-validation.

1. Introduction

Disaster recovery is a process of physical reconstruction, accompanied by linked and interdependent processes of social, economic, and psychological adjustment (FEMA, 2011; NRC, 2006; Neal, 1997; Phillips, 2013). Recovery conjures mental images of volunteers clearing debris, utility crews restoring power, houses being reframed, schools reopening, and repaired transportation arteries again flowing with traffic. These images demonstrate how recovery is multi-scalar, meaning that individuals, households, and communities, each experience different yet interrelated milestones on the way to restoring their pre-disaster functions (Palm, 1990). On average, larger social units, such as communities, tend to recover normal functioning more quickly (Bolin, 1982); however, there can be a large degree of variation in recovery among social units at the same scale (e.g., between individuals, between households). Likewise, the pace of disaster recovery can vary geographically across an impacted region, happening faster in some locations than others (Aldrich, 2012; Chang, 2010; Cutter et al., 2014a; Pais & Elliott, 2008). Therefore, intuitive as the recovery concept may appear, its social and spatial complexities create serious measurement challenges for disaster scientists.

Three inherent dimensions of recovery often prove troublesome to measure: meaning, extent, and location. The first aspect, meaning, is an etic versus emic dilemma. Disaster scientists removed from the disaster zone will measure recovery differently than community members who live through the recovery. Insider community members have been shown to qualitatively judge recovery based on non-physical elements of place, which are difficult to standardize and measure. These elements include, among others, psychological wellbeing (Erikson, 1976; Park, Miller, & Van, 2010), livelihood restoration (Park et al., 2010; Thorburn, 2009; Tobin-Gurley, Peek, & Loomis, 2010), resumption of household routines (Fothergill, 2004; Stough, Sharp, Resch, Decker, & Wilker, 2016), repair of social networks (Aldrich, 2012; Erikson, 1976; Weber & Peek, 2012), mended place attachments (Cox & Perry, 2011; Hull, Lam, & Vigo, 1994), and vibrancy of community life (Annang et al., 2016; Chamlee-Wright & Storr, 2009). Outsider disaster scientists, instead, frequently quantify recovery using tangible proxies such as housing reconstruction (Burton, Mitchell, & Cutter, 2011; Curtis, Duval-Diop, & Novak, 2010; Stevenson, Emrich, Mitchell, & Cutter, 2010), population restoration (Finch, Emrich, & Cutter, 2010), and economic rebound (Chang, 2010; Sayre & Butler, 2011), which are easier to measure using secondary data.

The second aspect, extent, refers to the level or degree of recovery. Although quantitative measures are better suited than qualitative assessments to gauge extent, challenges can arise when normalizing a recovery metric to make it comparable across locations or social units. Scholars vary in their normalization approaches, opting for either a static measure of recovery outcome (e.g., population count, housing

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https://doi.org/10.1016/j.apgeog.2018.08.003
Received 26 April 2018; Received in revised form 27 July 2018; Accepted 12 August 2018

stock), an approximation of a dynamic recovery process (e.g., pre-event population trend resumed, stabilization of economic flows), or a triangulation between the two (c.f., Rose, 2004; Chang, 2010; Sayre & Butler, 2011). Unlike disaster scientists, community members may not distinguish between the recovery process and recovery outcomes, instead interchanging these concepts in their assessments. Stevenson, Brown, Seville, and Vargo (2018) concede that a plurality of indicators is necessary to encapsulate the complexities of local recovery contexts. Moreover, they maintain that the appropriateness of different metrics and baselines for judging the extent of recovery varies temporally over the recovery period.

The third aspect, location, is problematic for several reasons. Depending on the loss agent, the resultant damage (and thus recovery) may or may not be readily observable across the entire disaster zone. For example, after a hurricane structural damage from storm surge and wind-blown debris would be more visible than interior damage from wind-driven rain or mold. While residents might be aware of such interior damage, disaster scientists employing exterior surveys or remotely sensed images would be unable to observe and account for such damage. Error introduced in maps of damage baselines would be propagated throughout later phases of a longitudinal recovery analysis. Notwithstanding disparities in exposure and observable damage, the uncertain geographic context problem (Kwan, 2012) may create further difficulties in measuring the location of recovery since residents' mental maps of neighborhoods and communities may not conform to spatial units that scholars commonly use for data aggregation (e.g., census tabulation areas, municipal boundaries). Additionally, impacted residents' relativistic views of recovery make it easier to identify recovery benefits accruing in other communities rather than one's own (Quarantelli, 1999). This phenomenon may lead residents to attenuate assessments of recovery within their own communities or to amplify recovery assessments elsewhere.

Considering these dimensions, the recovery measurements made by disaster scholars, while systematic, could differ substantially from assessments made by residents themselves. While no single indicator could reasonably be expected to present a complete picture of recovery, the ubiquity of quantitative spatial recovery indicators is striking given the absence of research demonstrating their correlation with community members' perspectives. In light of this gap, the current study poses a fundamental question: Do quantitative spatial recovery proxies hold parity with residents' qualitative assessments of recovery? Using a mixed methodology comprising semi-structured interviews, participatory mapping, GIS analysis, and self-organizing maps, this study leverages coastal Mississippi's long-term recovery from Hurricane Katrina as a test case for answering this research question. The study compares place-based recovery measurements obtained qualitatively and quantitatively, acknowledging value in both approaches and recognizing that the best recovery measurements should validate one another.

2. Defining and measuring recovery

2.1. Conceptual models

The question of how to measure disaster recovery is mired by disagreement among stakeholders as to what recovery entails. Scholars, politicians, emergency managers, and lay people casually interchange the terms “reconstruction,” “restoration,” “rehabilitation,” and “rebound” with recovery (Quarantelli, 1999); however, each term implies different objectives for recovery that variously emphasize buildings, population return, economic investment, beautification, urban growth, or environmental health. Interpretations of these recovery synonyms are reflected in the extant conceptual models of disaster recovery and in the quantitative indicators selected to empirically chart and compare recovery from place to place.

Cross-disciplinary disaster scholars have proposed models describing patterns of recovery at different scales. Community-level models emphasize various aspects: institutional roles in rebuilding infrastructure and repopulating damaged areas (Kates & Pijawka, 1977); capabilities of administrative structures to provide recovery leadership and financial resources (Rubin, 1985); and latent political-economic factors driving spatial patterns of post-disaster displacement and resettlement (Pais & Elliott, 2008). At the household level, Bolin and Bolton (1986) show differences in sources of support for economic and emotional recovery between racial/ethnic and socioeconomic groups; Quarantelli (1995) describes phases of sheltering on the road to re-establishing permanent housing; and Rathfon, Davidson, Bevington, Vicini, and Hill (2013) discuss stages of rebuilding for residential dwellings themselves. Ideally, recovery at both the community and household level should mitigate against future hazards (Berke, Kartez, & Wenger, 1993; Godschalk, Brower, & Beatley, 1989), reduce social vulnerabilities (Cutter, 1996; Wisner, Blaikie, Cannon, & Davis, 2004), and build adaptive resilience (Cutter et al., 2008; Folke, 2006; Olson, 2011), though rarely does this happen seamlessly or evenly across a disaster area.

Recovery has been conceptualized in the literature as both a dynamic process and as a static outcome, leading to variation in the way it is measured (c.f., Rose, 2004; Chang, 2010; Sayre & Butler, 2011). Recovery is commonly approximated in one of four ways: (1) return to pre-disaster levels, (2) return to the pre-disaster trajectory, (3) stabilization of a trend to a new normal, or (4) return to observed trends in comparable areas. Recovery assessments of the first type based on stock variables equate recovery to an outcome; the other approaches, which assess recovery based on trends or flow variables, exemplify recovery as a process. The current study describes methods for measuring and comparing both the speed (process) as well as the outcomes of recovery through quantitative and qualitative means.

2.2. Quantitative recovery measurement

On the whole, current empirical studies measure recovery with quantitative proxies that tabulate housing characteristics such as reconstruction, vacancy, affordability, resale, or tenure (Cutter, Schumann, & Emrich, 2014b; Kamel, 2012; Zhang & Peacock, 2010); population change (Cross, 2014; Finch et al., 2010; Li, Airriess, Chen, Leong, & Keith, 2010); receipt and adequacy of disaster aid (Gotham, 2014; Spader & Turnham, 2014); employment rebound (Schumann, 2013; Zottarelli, 2008), or business return (Hagelman, Connolly, Zavar, & Dahal, 2012; Xiao & Van Zandt, 2012). More sophisticated measurement approaches triangulate between several of these indicators (e.g., Chang, 2010; Horney et al., 2018; Stevenson et al., 2018). Cross-referencing housing counts with estimates of exposure or local social vulnerability increases the validity of quantitative, indicator-based studies (e.g., Van Zandt et al., 2012). Visual, spatial, and geo-statistical methods have also recently emerged as tools for quantifying reconstruction disparities across space (Burton et al., 2011; Curtis et al., 2010; Stevenson et al., 2010). Often data collection and analysis procedures common to quantitative approaches foster only limited engagement with residents’ place-based recovery knowledge. In the current study, four longitudinal quantitative indicators related to housing stock, population change, and economic resources are used to proxy recovery.

2.3. Qualitative recovery measurement

Two central questions guiding recovery research, “Recovery for whom?” and “Recovery to what?” (Cretney, 2017; Cutter et al., 2006; Gotham & Greenberg, 2008), invite qualitative consideration of the acceptability of recovery outcomes and the (in)equity of recovery processes. Key emergency management guiding documents underscore the importance of leveraging participatory methods to custom-tailor recovery plans and promote local primacy in recovery decision making (FEMA, 2011; United Nations, 2015). An array of qualitative