Barriers to Proactive Population Relocation in Preparation for Coastal Flooding

Vicki M. Bier*
University of Wisconsin-Madison, Madison, Wisconsin, USA

Abstract: Coastal flooding due to climate change may affect more than 10 million people in the U.S., and well over 100 million worldwide, creating a need for mass relocation and/or migration away from at-risk areas. Arguably, it would be preferable to gradually reduce the population living in vulnerable areas before they experience severe flooding (to reduce loss of personal property, disruption, and the cost of emergency response), but there seem to be numerous barriers impeding that goal. First, there are at least two different types of collective-action problems: collective action between jurisdictions; and collective action between current and future residents. There are also competing factors that may make moving inland undesirable, including not only coastal amenities, but also the economic benefits of agglomeration. The long time horizons involved in preparing for coastal flooding make investment in preparedness almost inherently a government problem (due to its relatively low social discount rate), but the wide range of federal, state, and local agencies involved may make it difficult for government to act effectively. Finally, psychic numbing may limit the public support for measures that do not reduce the at-risk population by at least an order of magnitude or more.

Keywords: Relocation, Displaced Persons, Climate Change, Coastal Flooding.

1. INTRODUCTION

The Risky Business Project [1] estimates that climate change will cost the U.S. hundreds of billions of dollars by the middle of the 21st century in "lost productivity, inundated housing and infrastructure along coasts, and plunging crop yields in key farming regions." In particular, the Risky Business Project predicts that $66 to $106 billion of property will be below sea level by 2050, and $238 billion to $507 billion by 2100, with more than half of the U.S. population living in coastal counties. Similarly, Melillo et al. [2] estimate that "more than $1 trillion of property and structures are at risk of inundation from sea level" between 2050 and 2070. According to the National Ocean Service [3], sea levels are currently rising at a rate of 1/8 inch per year, with the result that "nuisance flooding is estimated to be from 300 percent to 900 percent more frequent within U.S. coastal communities than it was just 50 years ago." Moreover, several sources have estimated that the rates of sea-level rise are accelerating [4-6].

Haer et al. [7] estimate that coastal flooding could result in the need to relocate several million people over decades, with impacts on U.S. GDP on the order of $100 billion. More dramatically, taking anticipated population growth into account, Hauer et al. [8] estimate that up to 13 million people may need to relocate away from coastal areas due to climate-related flooding; in fact, they observe that "the absence of protective measures could lead to US population movements of a magnitude similar to the twentieth century Great Migration of southern African-Americans." Internationally, the Union of Concerned Scientists [9] points out that "more than 100 million people around the world live within a mile of the sea." Hallegatte et al. [10] identify New Orleans, Miami, and Tampa as among the hardest-hit U.S. cities; New York and Boston are also sometimes cited among cities at great risk [11]. Therefore, given the likelihood of permanent sea-level arise affecting major urban areas, we need to be prepared to relocate large numbers of people in a cost-effective manner that also minimizes the social disruption and personal hardship experienced in the aftermath of Hurricanes Katrina and Sandy.

* bier@engr.wisc.edu

However, most efforts to date focus primarily on seawalls or flood-proofing of buildings in at-risk areas [12] and/or more resilient infrastructure systems such as backup generators or distributed generation [13], even though Freudenberg et al. [14] note that "Managed retreat is the strategy that most effectively eliminates risk." Where retreat is considered, it tends to be only after flooding has occurred [12]. Note, however, that retreating from affected areas only after flooding does not prevent the loss of personal property and personal, economic, and societal disruption that accompanies a disaster. For example, Eyer et al. [15] note that evacuees in the near aftermath of Hurricane Katrina tended to settle near New Orleans ("with little consideration for destination…characteristics" such as "wage rates, unemployment, and the cost of living"), while those who left New Orleans at other times (e.g., for economic reasons) chose destinations with more favorable economic conditions. Therefore, Meyer and Kunreuther [16] and Siders [17] explore mechanisms for encouraging relocation prior to a disaster (or after floods but before catastrophic levels of sea-level rise), such as zoning, buyouts, tax incentives, and public-private partnerships. However, numerous barriers impede proactive adaptation.

2. BARRIERS TO CLIMATE ADAPTATION

There is already a substantial literature on barriers to climate adaptation in general (not focusing specifically on relocation). Biesbroek et al. [18] list a number of these, including: conflicts between the long-term nature of climate change and short-term priorities; uncertainties; institutional challenges; lack of awareness; lack of willingness; and lack of resources (see also [19]). Bierbaum et al. [20] also highlight lack of leadership and divergent value judgments as additional barriers. References [21-23] discuss how some of these barriers played out in climate-adaptation projects in the Netherlands, the San Francisco Bay Area, and Florida, respectively.

With regard to proactive relocation in particular, the barriers to the adoption of managed retreat are important and numerous [14]. First, there are collective-action problems involved in managed retreat. One is a collective-action problem between multiple jurisdictions. For example, Olsen et al. [24] and Hecht [25] find that loss of property taxes can be a barrier to retreat from at-risk areas, especially if people relocate to different municipalities (e.g., from Coral Gables to inland areas of Miami). The "conflicting timescales" highlighted by Biesbroek et al. [18] can also create collective-action problems between current and future residents. Many people living in vulnerable coastal areas today may not expect to live there in 20-30 years, so may have little incentive to invest in adaptation.

The long timescales involved in sea-level rise pose another challenge. In particular, government typically has a lower "social discount rate" than most private companies (and many individuals). This suggests that investment in preparedness may require coordination between public and private decision makers in order to achieve desirable social goals. Thus, for example, if government wants to take action earlier than many private decision makers would, it could create incentives or "nudges" (e.g., tax breaks, or job creation in inland areas) to encourage private individuals and companies to start moving away from vulnerable coastal areas before they otherwise would.

As noted by Bierbaum et al. [20], conflicting values and trade-offs can also create barriers to relocation. In particular, even government agencies with low discount rates may not want to encourage relocation *too* soon. First, that would entail loss of the substantial economic benefits of agglomeration [26-27]. For example, there are sizable benefits to having musicians living in the French Quarter (rather than living outside New Orleans and commuting into town), or for companies that service the shipping industry to be located near the ports in Norfolk. Such concentrations of expertise and capital are valuable economically, so it would be desirable to develop thoughtful plans to maintain or relocate critical expertise, capital, and efficiencies. Moreover, even if the benefits of agglomeration are not significant on a societal scale, local considerations such as loss of tax base, tourism, or other revenues can also lead government not to favor early relocation.

Another potentially important values trade-off is simply the "coastal amenities" of living near the sea [28-29], which have economic value even if intangible. In particular, Bin et al. [29] explicitly quantify the increase in property value associated with factors such as having an ocean view or being close to

the beach, separately from the reduced property value associated with flooding risk. The fact that people are willing to pay for these amenities (and often substantial amounts) suggests that incentives to encourage residents to relocate away from coastal areas may likewise need to be substantial in order to be effective, and that encouraging people to relocate before it is truly necessary imposes real costs.

As noted by Biesbroek et al. [19], institutional fragmentation also creates barriers to relocation, since the wide range of federal, state, and local agencies involved can make government action difficult to coordinate. For example, the Monterey Institute of International Studies [30] documents over 150 federal offices and organizations that could be involved in some aspect of disaster preparedness or recovery, which can turn emergency planning and response into a "bureaucratic nightmare" [31]—and this does not even include all of the local agencies that are involved in zoning, decisions about where to locate schools and other services, etc. In some cases, the same agency (e.g., the Federal Emergency Management Agency) may pay both the cost of buyouts before a disaster, and the costs of post-disaster relocation—but in other cases, local tax districts may bear the cost of relocation while other agencies benefit from reduced post-disaster costs. Moreover, while municipalities may wish to be farsighted, they are nonetheless susceptible to political pressure from local constituencies over short-term goals (e.g., coastal residents who want amenities located nearby).

The effects of climate change can also be expected to be intermittent and uneven [32], exacerbating barriers due to uncertainty about the best course of action and the best time to take action. In particular, climate change can cause both chronic risks (e.g., due to steadily rising ocean levels and associated loss of land) and event-driven risks (e.g., due to storms). Chronic risks require different approaches to risk analysis and risk management than traditional probabilistic safety assessment, but can also complicate the analysis of catastrophic events, since for example flooding may incorrectly be viewed as a one-time event, rather than a sign of a worsening trend (or a one-time event that was made worse because of sea-level rise).

Finally, "psychic numbing" [33-35] can prevent communities from recognizing the substantial benefits to be gained by reducing the magnitude of disasters, even if it is not possible to eliminate them. In particular, the logistical difficulties and hardships associated with mass relocation are likely to grow faster than linearly in the number of people relocated. From this perspective, reducing the number of people who would need to be relocated in a severe flood (say, by encouraging anticipatory relocation) from a million to 500,000 would solve the most difficult part of the relocation problem, and make possible greater attention to the needs of the most vulnerable [36-37]. However, public perception of the severity of a large flood is likely to plateau (reflecting diminishing marginal concern as the number of people affected increases), in accordance with Fechner's law [38], or may even reflect psychic numbing (in which case relocation of a million people may be perceived as less catastrophic than a severe flood affecting a single family). If the benefits of anticipatory relocation are under-appreciated in this way, risk-reduction efforts may be dismissed as ineffective if they cannot achieve orders-of-magnitude reduction in flood risk.

3. ANTICIPATORY VS. FORCED RELOCATIONS

As noted in [39], planned vs. forced relocations can result in quite different final outcomes. For example, McMichael et al. [40] distinguish between "forced displacement" after a disaster, "planned resettlement" of large populations, and anticipatory migration of individuals. They focus primarily on experiences in developing countries, so their findings may be of limited relevance to the concerns in the U.S. However, they find that forced displacement results in significant health risks, including risks to mental health. Experiences with planned resettlement have likewise generally not been favorable, so that "planned resettlement must be the last resort where other adaptation strategies are ineffective or unavailable." Moreover, anticipatory migration is orders of magnitude less costly than planned resettlement of an entire community (which involves costs to build infrastructure that would already be available if people instead migrated to pre-existing communities). Thus, encouraging proactive migration appears to be a means of reducing both vulnerability and cost. Rose [41] notes

therefore that "climate change…could generate a new type of refugee, one with significant advanced time for planning."

Busby [42] observes that "Reducing risks ahead of time is almost always less costly than responding to disasters after the fact… the world currently spends too little on adaptive strategies that would reduce climate risk…" Similarly, the Wharton Risk Management and Decision Processes Center and Zurich Insurance Group Limited [43] to recommend that more resources be devoted to risk reduction, since "The high costs of recovery are unsustainable."

Unfortunately, social science suggests that people do not generally respond proactively in gradually worsening situations. Thus, Kousky [44] indicates that "Even when risk reduction measures have been shown to be cost-effective…it is difficult to inspire adoption… the occurrence of a natural disaster can serve as a focusing event, increasing attention on the risk and thus leading to more investments in mitigation." Similarly, Sadowski and Sutter [45] state that "communities rarely respond to hazards and consider mitigation until after a disaster occurs."

Thus, to encourage anticipatory migration in anticipation of climate change (rather than forced displacement after severe flooding has occurred), communities could adopt measures such as building schools or other new infrastructure inland; a similar approach was adopted to deal with earthquake risk in Iran, with over 100,000 people relocated out of Tehran as civil servants and their families were assigned to new locations [46]. However, this does not seem to be in keeping with the pressures faced by state and local authorities. For example, Platt [47] indicates that "The private and local levels of authority usually seek to at least rebuild the *status quo ante*, and preferably bigger and better… Mitigation has been a key element of national disaster policy and programs… Yet FEMA today seeks to devolve responsibility for mitigation to lower levels of government…" Moreover, state and local governments are not always farsighted in how they handle these responsibilities; thus, for example, North Carolina has actually banned the use of mathematical models showing accelerated rates of sea-level rise in setting policies for coastal management [48].

Advance planning is likely to be particularly important when community input is highly valued, so that lengthy community-involvement processes do not impede timely response. This may be facilitated by focusing on small wins ("small and modest breakthrough and/or innovative strategy development") [49-50]—achieving feasible goals that may help participants develop a sense of efficacy that would enable them to tackle bigger problems in future. McDaniels et al. [51] outline a more quantitative, ranking-based approach for setting priorities to mitigate disasters in a city or metropolitan area; however, the focus again is on "practical steps" and "implementable methods," making it possible to improve disaster preparedness even in the face of numerous barriers. Likewise, given the impracticality of relocating entire communities out of at-risk zones, the Oregon Seismic Safety Policy Advisory Commission [52] has prioritized relocating "essential buildings and functions" such as "police stations, fire stations, government offices, hospitals, public works, and similar critical facilities" over a period of time.

In addition, since government typically has a lower "social discount rate" than most private individuals, it may be possible to design "win-win" incentives to encourage relocation by individuals who would not otherwise choose to relocate (thus reducing both eventual government emergency-response costs as well as individual flood losses). For example, relatively modest incentives or "nudges" encouraging inland development (similar to "economic development zones") may take effect only slowly, but at the margin may influence people's location decisions, especially at times when they are likely to relocate anyway (e.g., at times of children starting school or graduating, job changes, or retirement). Hayat and Moore [53] go further, suggesting that national flood insurance be made contingent on an agreement to relocate "following floods that cause substantial damage."

4. CONCLUSION

Surprisingly little is known about the costs and impacts of mass relocations. Formal processes of disaster planning and management in the U.S. address temporary or short-term emergency housing needs, but involve little or no provision or planning for long-term post-disaster housing, or for encouraging relocation prior to a disaster. This underscores the importance of research and planning to improve resilience after long-term displacement, and to ensure that mass relocations proceed as smoothly as possible.

Historically, the issue of retreat from at-risk coastal areas has received little attention, with many scholars viewing the trend of increased population in coastal areas as being essentially immutable. For example, the Subcommittee on Disaster Reduction [54] has studied coastal inundation, but their recommendations do not include strategies for permanent retreat from at-risk areas. It might be possible to encourage relocation prior to a disaster through mechanisms such as tax incentives, zoning, or the location of important services and amenities farther inland. However, given the pressures faced by local governments [47], there may be a need either for new planning approaches, or for ways of changing the public dialog to reinvigorate previously existing tools like zoning. More work would also be desirable on planning methods to motivate action and help communities or other organizations achieve consensus on priorities [49-51]. Hopefully, research in these areas on topics will help to identify ways to better prepare for and manage the risks of mass relocation in the U.S. and elsewhere.

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