

Social Dynamics of Flood Hazard Zone Development and Retreat:  
How Physical Scientists, Engineers, and Social Scientists Can Assess and Remedy Imperfections  
in Hazard Zone Housing Markets.

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This research program would address four hydrometeorological hazards—hurricanes, tsunamis, inland flooding, and flooding caused by land subsidence. The first research objective would be to examine the current incentives for local jurisdictions to allow different types of development (e.g., land use and building construction decisions) in flood hazard zones. This analysis would examine three categories of stakeholders—real estate developers, prospective home buyers, and local governments. The incentives for real estate developers are derived from their response to market demand for residential, commercial, and industrial construction. The incentives for prospective home buyers arise from their desire for convenient home or business locations at a reasonable price. However, local government has conflicting incentives. On the one hand, there is support for developers in promoting local economic development. On the other hand, local government wants to protect homeowners from disaster impact. Housing markets in hazard prone areas have major imperfections—the most significant of which are asymmetries of hazard exposure and hazard information. Developers typically have a very short hazard exposure (approximately one year while houses are being built) and a substantial amount of information about flood hazard. By contrast, prospective homeowners are exposed for the duration of their residence in the flood zone, are ignorant about or misinterpret flood probabilities, and are overconfident about the effectiveness of engineered protection works such as levees. Local elected officials can expect the positive consequences of flood zone development to occur in the short term and the negative consequences to occur in the long term. Thus, the incentive structure of the flood zone’s housing market encourages elected officials’ to make myopic development decisions that are likely to produce disastrous consequences only after their terms of office are over. Accordingly, the major goal of this research objective would be to assess how local

governments frame flood zone development decisions and balance the competing goals of economic development in the flood zone against the avoidance of flood disasters.

The second research objective concerns what policies, tools, and strategies communities have for affecting development decisions. These can broadly be characterized as incentives (“carrots”), restrictions on land use and building construction (“sticks”), and risk communication (“sermons”)? Among others, these policies include the following options.

- Restricting upzoning to *allow* specific categories of development—high intensity development (high rise multifamily), moderate intensity development (low rise multifamily and small lot single family), low intensity development (large lot single family), and undeveloped (agricultural) areas— that are appropriate for each hazard zone.
- Restricting upzoning to *preclude* specific categories of development (schools, hospitals, nursing homes, jails).
- Establishing building codes that require elevation or floodproofing.
- Refusing flood insurance coverage for structures that fail to meet zoning or building code requirements.
- Downzoning hazard zones to restore wetlands and other open space to accommodate flooding.
- Purchasing structures in floodplains in order to demolish or remove them.
- Transferring development rights to locations outside hazard zones.
- Providing risk communication that informs prospective buyers of current and future floodplain risks.

The principal goal of this research objective would be to assess the perceptions that the principal stakeholders—real estate developers, local government (elected officials and land use planners), and local residents—have of the advantages and disadvantages of these land use management policies, tools, and strategies.

The third research objective concerns the ways in which developers’ and local officials’ development decisions and homeowners’ house purchase and insurance purchase decisions are affected by a variety of conditions. One important set of conditions concerns risk communication messages (e.g., verbal, numeric, and graphic information about hazard probabilities and scientific uncertainty about hazard zone boundaries) from different sources (e.g., scientists), through different channels (e.g., hazard awareness brochures). Additional influences include different

stakeholders' planning horizons for increasing (or recently recognized) threats, their disaster experience, and their beliefs about the appropriateness of government intervention in housing markets.

The fourth research objective addresses a fundamental premise of hazard zone mapping—that planners can define hazard zone boundaries by thin lines on a map. This is a convenient fiction when the environment is stable and becomes increasingly problematic as flood zones are forecast farther into the future of a changing environmental system (e.g., due to climate change or upstream development). The principal goal of this research objective would be to conduct hydrological analyses that produce the best scientific estimates and uncertainty bounds for the hazard zones of flooding events with different recurrence intervals for current conditions and for projected future conditions (increased coastal flooding from sea level rise and inland flooding from upstream development).

The fifth research objective would examine how additional analyses can shed light on scientific justification for development decisions. These analyses include hydrological and structural engineering analyses to reduce uncertainty about hazard zone boundaries, as well as econometric analyses of property parcel sales data to assess the economic impacts on local businesses (especially real estate and hospitality industries) of establishing new hazard zones or redefining existing hazard zones. In particular, the econometric analyses could address business owners' concerns that hazard zones *stigmatize* their communities, thus depressing local economic activity such as tourist revenues and property prices. These additional analyses also would include information flow analyses to identify the sources from which developers, land use planners, and hazard zone occupants obtain and interpret information about current and projected hazard exposure and the perceived characteristics of those sources. Finally, the additional analyses include comparisons to existing programs for buyouts of properties in inland floodplains to see if strategies for coastal hazard zone retreat would experience similar patterns of hazard zone occupant compliance/resistance.

The sixth research objective is to assess different floodplain occupants' (e.g., homeowners and renters in different population segments, businesses of different sizes and in different economic sectors) expectations about the likelihood of experiencing a disaster in the next 5 years under current conditions and the likelihood of experiencing a disaster in the next 50 years due to upstream development and increased rainfall (inland flooding) or sea level rise (coastal

flooding). This research objective would also address these stakeholders' expectations of the adequacy of savings, disaster relief, and hazard insurance in rebuilding their homes/businesses after a disaster, as well as the conditions under which they would migrate to a safer location rather than rebuild after a disaster.

### *Research Methods*

The research methods for this program will include a variety of quantitative and qualitative methods. These include case studies, semi-structured interviews (planning and building construction agency staff, business owners/managers), hydrological and structural analyses, econometric analyses of property parcel sales data, surveys past behavior (revealed preference studies), and field experiments of risk area residents' expected behavior (expressed preference studies).

The proposed research program would be conducted in a variety of regions—Gulf and Atlantic coastal counties for hurricanes and riverine flooding, Pacific coastal counties for tsunamis and riverine flooding (and landslides) from severe storms, Great Lakes coastal counties for lake level variation and riverine flooding, and counties in inland states for riverine flooding. The states should be selected after consideration of their variation in land use and building construction regulations (e.g., Oregon restrictions on siting special facilities in tsunami zones) and other locations should be selected on the basis of their experience with subsidence (e.g., Galveston Bay from water and oil extraction, New Orleans from groundwater pumping and dewatering) or expansion of 100-year floodplains from upstream development (e.g., Houston in Hurricane Harvey).

### *Program Impact*

This program has the potential to produce significant advances in the fields of economics, environmental and structural engineering, hydrology, planning, political science, psychology, and sociology, and a significant reduction in disaster impacts: Physical (casualties and damage) and social (psychological, demographic, economic, and political).

### *Supporting Evidence for the Program*

These issues have been addressed in a number of publications from NSF's Second Assessment of Research on Natural Hazards, a similar NAS/NRC report, and more recent journal articles on land use management (see below).

Burby, R.J. (Editor) (1998). *Cooperating with nature: Confronting natural hazards with land use planning for sustainable communities*. Washington, DC: Joseph Henry Press.

Ge, Y. & Lindell, M.K. (2016). County planners' perceptions of land use planning tools for environmental hazard mitigation: A survey in the U.S. Pacific states. *Environment and Planning B: Planning and Design*, 43, 716-736.

Greer, A., & Brokopp Binder, S. (2017). A historical assessment of home buyout policy: Are we learning or just failing? *Housing Policy Debate*, 27(3), 372-392.

Kunreuther, H. & Roth, R.J., Sr. (Editors) (1998). *Paying the price: The status and role of insurance against natural disasters in the United States*. Washington DC: Joseph Henry Press.

Lindell, M.K., with Alesch, D., Bolton, P.A., Greene, M.R., Larson, L.A., Lopes, R., May, P.J., Mulilis, J-P., Nathe, S., Nigg, J.M., Palm, R., Pate, P., Perry, R.W., Pine, J., Tubbesing, S.K. & Whitney, D.J. (1997). Adoption and implementation of hazard adjustments. *International Journal of Mass Emergencies and Disasters Special Issue*, 15, 327-453.

Lindell, M.K. (Editor) (in press). *Disaster resilience: Integrating mitigation, preparedness, and recovery planning*. New York: Routledge.

Mileti, D. (1999). *Disasters by design: A reassessment of natural hazards in the United States*. Washington, DC: Joseph Henry Press.

NAS/NRC. (2006). *Facing hazards and disasters: Understanding human dimensions*. Washington DC: Author.

Sapat, A. & Esnard, A-M. (Editors) (2017). *Coming home after disaster: Multiple dimensions of housing recovery*. Boca Raton FL: CRC Press.

Tang, Z., Lindell, M.K., Prater, C.S., Wei, T. & Hussey, C.M. (2011). Examining local coastal zone management capacity in U.S. Pacific coastal counties. *Coastal Management*, 39, 105-132.

Tierney, K.J., Lindell, M.K. & Perry, R.W. (2001). *Facing the unexpected: Disaster Preparedness and Response in the United States*. Washington DC: Joseph Henry Press.