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NATURAL HAZARDS CENTER

Hazards and Disasters Researchers Meeting

Beginning in 1997, hazards and disaster researchers gathered from a variety of academic areas to present and discuss their current research. Since then, the meetings have provided the opportunity for investigators to depart their disciplinary confines and enter a forum of multidisciplinary discussion to present and provide feedback on recent results. Drawing participants from across the country, this meeting serves as a cornerstone event for academic explorations in the field of hazards and disasters. As a new feature of this year's meeting, short papers based on the research presented were compiled and published as proceedings.

The HDRM Proceedings offer a collection of short papers presented at this two-day meeting held in Boulder, Colorado, on July 11 and 12, 2007, following the annual hazards workshop. The meeting brought together more than 100 researchers to scholarly findings on various aspects related to hazards and disasters. The presentations addressed aspects related to vulnerable populations, risk and decision making in hurricanes, recovery and reconstruction, and multiorganizational collaboration.

The short papers are lightly edited to match the Natural Hazards Center style. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Natural Hazards Center.

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The First Round: An Assessment of Local Hazard Mitigation Plans in California under DMA 2000

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Abstract

This paper assesses local hazard mitigation planning lessons in California. Through a grant from the Governor's Office of Emergency Services (OES) for revision of the State Hazard Mitigation Plan, California Polytechnic State University-San Luis Obispo reviewed 436 Federal Emergency Management Agency (FEMA) approved Local Hazard Mitigation Plans (LHMPs). Analytic objectives were to describe contents of LHMPs based on FEMA guidance, identify areas of deficiency in LHMP content and quality as well as inconsistency with state plans and goals, and assess determinants of plan quality so that OES and FEMA can address the broader policy framework and implications of the LHMP program. Although all plans met minimum FEMA standards under DMA 2000, there was substantial variation in plan quality. For example, there was a lack of consistency in definition of concepts and categorization of hazards. Hazard-ranking schemes varied, and methods were sometimes insufficiently documented. A questionnaire survey of cities and counties revealed additional factors, such as extent of citizen participation, linkages between LHMPs and local comprehensive planning, and relationships with grant-funded hazard mitigation projects. From the preceding research, the picture that emerged is that local government participation in mitigation planning is significant in California and overall of good quality. The question is raised: How can local hazard mitigation planning be further improved in California as well as the nation as a whole?

Key Words: DMA 2000, local hazard mitigation planning

Introduction

Adoption of a Local Hazard Mitigation Plan (LHMP) is a precondition for receipt of local Hazard Mitigation Grant Program (HMGP) project funds under the Disaster Mitigation Act of 2000 (DMA 2000).[1] The intent of DMA 2000 was to reduce preventable disaster losses by encouraging both states and local jurisdictions to plan to mitigate risk from natural hazards in advance of natural disasters. FEMA has established rules requiring local governments to demonstrate that proposed mitigation actions are based on a sound planning process that accounts for inherent hazards, vulnerabilities, and capabilities of the individual jurisdiction.[2] The first round of local mitigation plans began emerging in 2003, but there is no literature reviewing or evaluating them as mitigation tools.

DMA 2000 requires states to examine LHMPs in undertaking their state hazard mitigation planning processes. As part of an update of the California State Multi-Hazard Mitigation Plan, we analyzed the content of 436 locally adopted, FEMA-approved LHMPs and surveyed local officials in charge of the LHMP development process.[3] From this analysis, we are able to describe the state of local hazard mitigation planning in California under the DMA 2000. Further, we draw conclusions related to planning processes, plan content, and plan quality and offer recommendations for improving LHMPs.

Background California Hazard Mitigation Planning Context

The Governor's Office of Emergency Services (OES) administers the LHMP Program for California. OES assists local governments in the development of LHMPs and tracks their progress and effectiveness. An OES goal is for all local governments in California to have FEMA-approved LHMPs. Table 1 indicates the overall status of LHMPs and the populations covered in California.

As of August 7, 2007, the State of California had a total of 603 locally adopted, FEMA-approved plans, including those of 241 cities, 30 counties, and 332 special districts. LHMPs for cities and counties cover 26,482,787 people, or 71% of California population. An additional 9% of the state's population will be covered by LHMPs currently in the review process, for a potential total of 80% of the population covered in the next few years. Communities choosing not to prepare an LHMP tend to be smaller and have higher percentages of households below the poverty line than communities that prepared LHMPs. This may show that these communities are not able to initiate LHMP planning processes due to fewer resources, such as staff and funding.

Method

In updating the California State Multi-Hazard Mitigation Plan (SHMP), we undertook an evaluation of all locally adopted and FEMA-approved LHMPs as of January 1, 2007. There were three objectives of the analysis. First was to describe the contents of the LHMPs based on standards from the FEMA guidance and on issues of concern to the OES update of the 2004 SHMP. Second was to identify areas of systematic deficiency in LHMP content and quality and to identify areas of systematic inconsistency with state plans and goals so that polices and programs can be developed to address these issues. Third was to assess the determinants of plan quality so that OES and FEMA can address the broader policy framework of the LHMP program.

LHMP requirements under CFR 44.201.5 apply to both local jurisdictions (cities, counties, school districts, and special districts) and tribal governments that elect to participate in FEMA mitigation grant programs as a sub-applicant or sub-grantee. The requirements for these LHMPs are documented in federal guidelines known as the "Blue Book."[4] OES and FEMA evaluate and approve LHMPs using a checklist titled the "Plan Review Crosswalk" documented in the Blue Book. Each Crosswalk requirement includes separate elements that function as minimum review standards.

The research instrument for gathering data from the LHMPs was a set of prompts based on the Plan Review Crosswalks and plan update needs. Data from the LHMPs are stored in quantitative and qualitative format in an MS Access database. In addition to the plan analysis, we conducted a survey of cities and counties concerning their LHMPs. The survey addressed similar areas as the LHMP analysis and included numerous open-ended questions aimed at providing OES with a better picture of the challenges faced by local jurisdictions. Thus the survey serves as both a data instrument and a state-local planning feedback form. For the survey, all cities and counties with completed LHMPs (whether approved or still in process) were surveyed, totaling 317 jurisdictions, using a Web-based survey instrument (SurveyMonkey). The survey link was e-mailed to the LHMP primary contact, as recorded by OES at the time of plan submittal, and followed-up with reminders. The response rate was 57%, thus achieving a sampling error of less than ±5% (95% confidence interval). The survey questions were designed to expand understanding of the LHMP process beyond what was documented in the LHMPs themselves. In addition, several questions were included to provide OES direct feedback on the LHMP program and OES' role.

General Assessment of Trends and Plan Quality

The picture that emerges from analysis of California's LHMPs is that of a state in which local government participation in mitigation planning is significant and overall of good quality. The following are positive aspects found in most LHMPs:

- Substantive citizen participation
- Establishment of formal mitigation advisory bodies
- Identification of hazards and consistency in prioritization of those hazards with the state perspective
- Use of best available data on hazards from federal and state sources
- Adherence to "best practices" for vulnerability as-

Table 1. LHMP status as of August 7, 2007.

		Approved and Adopted Plans		In Process Plans
Jurisdiction Type	Number of Jurisdictions in CA	Number and % of Total	Population Covered and % of State Total†	Population Covered and % of State Total†
City	478	241 (50%)	21,435,195 (57%)	3,412,992 (9%)
County (Unincorporated)	58	30 (52%)	5,047,592 (13%)	90,323 (<1%)
Special District/ Other	4,400	332 (8%)	NA	NA
TOTAL		603‡	26,482,787 (71%)	3,503,315 (9%)
† Based on 2006 DOF Population Estimates (State population total = 37,444,385)				
‡ Estimated from "California State Government Guide to Government from the League of Women Voters of California" (Retrieved June 15, 2007 [http://www.guidetogov.org/ca/state/overview/districts.html])				

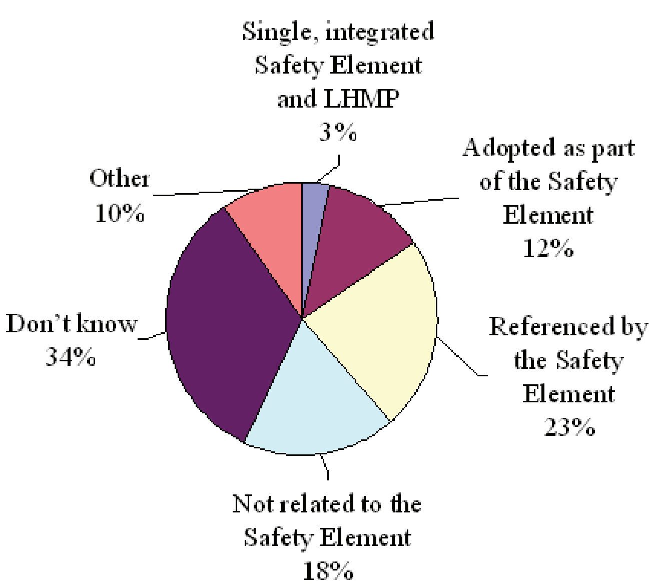
sessment (primarily FEMA "How-To" Guides)
- Adoption of mitigation measures that reflect the jurisdiction's hazard profile
- Satisfaction of local officials with state and federal technical support and with the benefits of adopting an LHMP

There are, however, several areas of concern. First, multi-jurisdictional plans often indicated minimal effort from local jurisdictions to establish unique vulnerability assessments and mitigation measures. Instead, in some multi-jurisdictional plans, the local jurisdictions were too deferential to the lead agency.

Second, 83% of LHMPs marginally addressed future land use and development trends and how they affect hazard and risk assessment, despite this being a FEMA requirement. The significant population growth projected for California over the next 40 years will likely dramatically change the state's risk profile. Although local planning departments played an important role in preparation of most LHMPs, it appears that their special expertise in growth and development was not fully utilized. Proper land use planning is one of the most effective hazard mitigation strategies.

Third, most LHMPs showed little or no connection to comprehensive General Plan Safety Elements (see Figure 2 below). California is one of less than a dozen states requiring local governments to include a natural hazards element in their comprehensive general plans. In light of the overlapping content, the integration of LHMPs with Safety Elements would provide a powerful mechanism for ensuring integration of hazard reduction and mitigation considerations with land use, infrastructure, transportation, and environmental decisions. The recent adoption of legislation (AB 2140, "General Plans: Safety Element" signed September 29, 2006) incentivizing the integration of the LHMP and Safety Element will hopefully change this current deficiency.

Figure 2. Integration of LHMP with the safety element.



Fourth, LHMPs generally had a "catch-all" approach to establishing mitigation measures; this resulted in extensive lists of unprioritized projects. This could result in inefficient use of resources and insufficient mitigation. Moreover, non-mitigation activities (usually response activities) dominated these plans. Although it is understandable that jurisdictions would want to capitalize on any opportunity to support the entirety of their emergency management needs, there is a potential for mitigation to remain in its historic position of lowest priority.

Fifth, if the state hopes to have an integrated approach to hazard mitigation that has all levels of government working together, LHMPs will need to integrate the variety of state agency plans that address hazard mitigation. The LHMPs have almost no linkage to statewide hazard mitigation efforts. The state has undertaken particularly significant mitigation planning efforts for California's three primary impact disaster sources: earthquakes, floods, and wildfires. As an outcome, California has a number of hazard-specific mitigation plans in place that have been approved by FEMA, including the California Earthquake Loss Reduction Plan, California Fire Plan, and State Flood Hazard Mitigation Plan.

Sixth, of concern is that 47% of jurisdictions do not know how they will fund their identified mitigation measures (a majority will rely on general funds) and very few can even estimate how much money they will spend over the next five years. More than 80% cited insufficient funds and staff as constraints on implementation. In addition, 25% cited lack of technical expertise as a constraint. The findings suggest that a focus on LHMP preparation is not enough to ensure that hazard mitigation occurs at the local level.

Seventh and finally, documentation and concept definition was very uneven within and among plans. This made plans difficult to follow and made them non-comparable with other plans. The latter concern makes statewide aggregation of local plan data difficult and could inhibit regional planning. Examples include:

- Important concepts are inconsistently defined and used from jurisdiction to jurisdiction (e.g., critical facilities, loss estimate, risk assessment)
- Hazards are inconsistently defined or categorized (e.g. landslide, tsunami)

- Hazard ranking schemes varied
- Methods are insufficiently documented

LHMP Quality

As part of the content review, each LHMP was assigned an overall quality score of high, medium, or low. This was based on the judgment of the reviewer considering factors such as consistency with FEMA guidelines, comprehensiveness, cohesiveness, and documentation of findings and reasoning. Several trends emerged in higher quality plans that provide some possible directions for further consideration of federal and state support for local planning.

- They had formally established advisory bodies
- They had substantial citizen participation
- They were supported with Pre-disaster Mitigation funds
- They were prepared with consultant support
- The communities generally had higher socioeconomic status indicators
- They were single-jurisdiction plans rather than multi-jurisdiction plans

These factors should not be interpreted as necessary conditions, but they do provide direction for further consideration of federal and state support for local mitigation planning.

Recommendations to State OES

Based on the LHMP analysis and OES' experience with administering the LHMP program, we have offered 14 specific recommendations for improving LHMP performance and consistency with state needs and objectives.

1. The state should establish consistent definitions for common concepts, such as critical facilities, loss estimate, and risk assessment.
2. The state should establish consistent definitions and categories for hazard types.
3. The state should ensure that all LHMPs describe the relative vulnerability of the jurisdiction to each hazard. The Calculated Priority Risk Index (CPRI) method is a potential common method that could be required.
4. The state should establish consistent reporting requirements for type and number of critical facilities and structures at risk.
5. The process of preparing and updating LHMPs should incorporate members of the general public and pay special attention to recruiting traditionally disenfranchised groups.
6. Local jurisdictions should be encouraged to take advantage of the financial benefits of AB 2140 by either creating integrated LHMP-Safety Elements or by adopting their LHMP as an annex to their Safety Element.
7. If local jurisdictions participate in multi-jurisdiction planning efforts, they should clearly address regional integration and cooperation, and the individual jurisdictions' unique hazards, vulnerabilities, opportunities, and constraints.
8. The state should clarify the difference between mitigation measures from response and recovery measures and ensure that LHMPs are focused on mitigation measures.
9. The state should require that each identified mitigation measure be assigned to a standard category—possibly based on OES' grants management database categories—so that the state can effectively determine the needs of the state as a whole. In addition, each mitigation measure should have an estimated cost.
10. State agencies should prepare guidance on how LHMPs can be developed to ensure consistency and coordination with other state hazard plans.
11. The state should address implementation of LHMPs, especially by providing assistance to local jurisdictions on how to finance their mitigation measures beyond dependency on federal grants (e.g., HMGP, PDM).
12. The state should more carefully review LHMPs to ensure that future growth and development trends are accounted for in the vulnerability analysis.
13. OES, professional planning organizations, and municipal organizations should ensure that local governments understand the benefits of integrating their LHMPs and Safety Elements.
14. State agencies with hazard mitigation plans and programs should prepare recommendations for how local governments can incorporate mitigations that support broader state efforts.

Concluding Observations

Study findings provide an initial insight into the character of local responsiveness in one state to DMA 2000 as a national effort to improve the quality of local hazard mitigation planning and projects. No systematic literature presently exists to assess this national experiment. Although the study provides a basis for improving LHMP processes within California, the broader question remains: How can local hazard mitigation planning be improved in the nation as a whole?

Notes

[1] Disaster Mitigation Act of 2000, P.L. 106-390.

[2] Code of Federal Regulations (CFR) 44 Part 201.

[3] The California Governor's Office of Emergency Services contracted with the City & Regional Planning Department at California Polytechnic State University-San Luis Obispo to update the 2007 State Multi-Hazard Mitigation Plan.

[4] *Multi-hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000* (March 2004).

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Code of Federal Regulations (CFR) 44 Part 201.

Disaster Mitigation Act of 2000, P.L. 106-390.

FEMA 2004. *Multi-hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000.*

Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288.

State of California. Assembly Bill 2140, "General Plans: Safety Element", signed September 29, 2006.

Condominium Housing Reconstruction Issues and Policies after Taiwan 921 Earthquake

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Abstract

The cost of post-disaster recovery has been staggering, especially for housing reconstruction in the aftermath of the devastating 921 earthquake in 1999. Due to multiple property ownership and collective decision making during reconstruction, condominium housing recovery is more complicated and far slower than other types of reconstruction. Thus, a number of new policies were promulgated in order to solve the many problems emerging during the recovery process. This paper first reviews recovery problems and related policies in regard to condominium housing reconstruction. Taichung County, one of the most severely damaged areas, was selected as a case study for examining the effects of these policies on the speed of recovery of condominium housing. At the end of this paper, research findings and recommendations for condominium housing recovery are presented to share with members of the hazards research and applications communities.

Introduction

Earthquakes have been common in Taiwan's recorded history with a major earthquake occurring, on average, every 1.1 years and registering from 5.3 to 8.3 on the Richter scale. Among them, the most devastating disaster has been the 921 earthquake (the Chi-Chi earthquake) measuring 7.3 on the Richter scale, which occurred on September 21, 1999. This quake struck the central part of Taiwan and killed 2,455 people; 38,935 houses collapsed and another 45,320 houses were partly damaged. It is notable that a significant number of collapsed housing included 161 "condominium communities"[1] with more than 10,000 housing units.

Comerio (1997) stated that housing is the single greatest component among losses incurred in recent urban disasters. Obviously, housing recovery is one of the most important issues after a catastrophic disaster as it is the victims' most fundamental need to resume their normal activities (Bolin and Stanford 1991; Quarantelli 1982). While much empirical research has focused on the socioeconomic aspects of housing recovery (Yeh 2006; Chen and Lin 2004), pre-disaster social inequity (Bolin and Stanford 1998; Peacock and Girard 1997), and the characteristics of affected households or communities (Zhang and Peacock 2003; Wu and Tszeng 2005), very few researchers have examined housing recovery policy and its effect.

This paper first focuses on the dynamic changes in condominium housing reconstruction policies and then addresses the way these policies have responded to the barriers encountered. Next, a case study shows the policy's effects on the speed of condominium reconstruction. The establishment of the condominium community's reconstruction committee and the approval data of reconstruction building permits are used to represent housing reconstruction speed. At the end of this paper, research findings and recommendations for condominium housing recovery are presented to share with hazards research and applications communities.

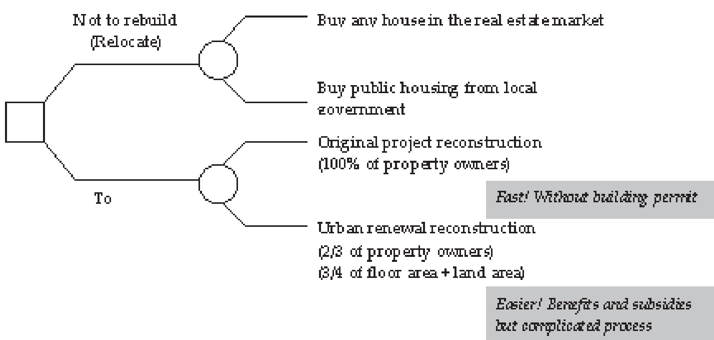
Condominium Housing Recovery

The 921 earthquake caused a large proportion of the condominium communities to collapse; condominium housing reconstruction has thus become one of the most important issues facing post-earthquake recovery. Among different building types, condominium housing recovery is probably the most difficult because these communities are rarely held by a single owner or limited investors. Typically, condominiums have common property ownership so collective decision making is required for reconstruction.

In general, the households of collapsed condominium communities had two options: to rebuild or not to rebuild. Those who didn't want to rebuild could either purchase homes in the real estate market or buy public housing from the local government at a discounted rate. For those who opted to rebuild, there were two approaches for reconstruction. First was Original Project Reconstruction

(OPR), which was the fastest route to reconstruction because no building permit was required as long as all property owners agreed to rebuild at the same location and maintain the original height and floor area. Unfortunately, in most cases it was too difficult for property owners to reach an agreement. Urban Renewal (UR) then became the major approach to rebuild the "condominium community" since only two-thirds of property owners with more than three-quarters ownership of the floor area and the land area were required (see Figure 1). In addition, specific benefits and subsidies were provided for using UR. Although UR was the easier reconstruction approach, the complicated administration process made condominium recovery a painful process.

Figure 1. Options for Collapsed Condominium Housing Reconstruction Condominium Housing Reconstruction Plans



Various condominium reconstruction plans were made to solve the difficulties emerging in the 921 earthquake recovery phase. In general, the most significant plans were made by two recovery authorities—the 921 Earthquake Post-Disaster Recovery Commission (921 ERC) and the 921 Earthquake Relief Foundation (921 ERF). The 921 ERC, created by the Executive Yuan on September 27, 1999, was the major government authority in charge of the implementation of recovery tasks. It was reorganized immediately after the presidential election in May 2000.[2] The other authority, the 921 ERF, was founded on October 13, 1999, as an "official" non-governmental organization (NGO) to utilize the $4 billion (U.S. currency) relief. To cope with the complexity of condominium housing recovery, different plans were developed by both authorities in order to speed reconstruction. The framework of these plans was a two-tiered system. The principle of the governmental authority plans was market-driven, whereas the NGO's plans usually supplemented inadequate governmental policies.

For most disaster victims, the financial burden was usually the first obstacle they faced while moving forward to recovery. Therefore, the first plan proposed by the 921 ERC was Preferential Loan. Three billion dollars (U.S. currency) was appropriated for banks to make low-interest loans to affected households for reconstruction, repairs, or home purchase. However, poor financial situations and a lack of mortgages made many victims ineligible for the plan. Only $3 million (U.S. currency) had been loaned half a year after the plan was issued. In addition, the complicated, drawn-out UR procedures also reduced victims' incentives to rebuild their homes. The 921 ERC recognized the necessity for simplifying the administrative procedures of UR and soon announced special UR plans for condominium housing reconstruction. For instance, a floor area ratio reward and a shortening of public waiting time were proposed. One of the most important plans lowered the UR requirement for applications from two-thirds to one-half of the property owners so that the affected condominium communities could more easily meet the minimum requirement.

With an NGO basis, the 921 ERF played a significant role in promoting condominium housing recovery since it had fewer administrative and legislative limitations. In order to increase the application rate for the 921 ERC's Preferential Loan, the 921 ERF created Credit Guarantee Funds for Building Reconstruction (CGFBR). Through CGFBR, $60 million was appropriated as credit guarantee funds with the hope that with these funds the banks would be more willing to make loans to the Urban Renewal Reconstruction Committee (URRC) for rebuilding. Another significant plan proposed by the 921 ERF was the Nest Building Project (NBP). Under NBP, three programs were developed. As mention earlier, it was possible for most condominium communities to use UR as a recovery approach. However, the Urban Renewal Ordinance (URO) was promulgated just one year prior to the earthquake. The low application rate was not surprising since most administrative officials and victims were not familiar with its procedures. To raise the application rates of UR, the 921 ERF first developed the Urban Renewal Reconstruction Program (URRP) in September 2000. Through URRP, the 921 ERF used publications such as manuals, handbooks, and brochures, and held training workshops and outreach activities to promote the urban renewal concept. In addition, the 921 EPDRC also subsidized URRCs' administrative and professional teams' consulting fees.

One year later, it became apparent that most condominium communities still could not meet the new UR requirements. In addition, URRCs still lacked reconstruction funds so they were not able to start reconstructing their communities. The

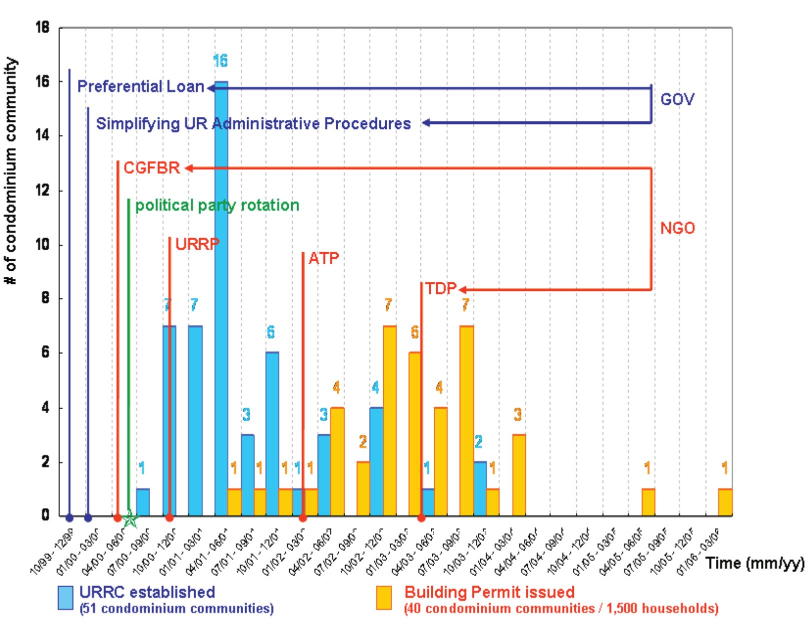
Approaching Threshold Program (ATP), which focused primarily on helping condominium community reach the threshold of UR, was created by the 921 ERF at the end of 2001. For condominium communities that could almost meet the minimum UR requirements, the 921 ERF would pay for the necessary property ownership and appropriated $3 million dollars (U.S. currency) without interest to URRCs as reconstruction funds. Four years after the earthquake, when the real estate market revived, a few construction companies became interested in condominium reconstruction. The 921 ERP then stopped ATP and created the Touch-Down Program (TDP). Under TDP, the 921 ERF provided subsidies for interest payments and trusts as well as the reconstruction fee for public facilities at condominium communities.

Condominium Housing Recovery in Taichung County, Taiwan

Timely reconstruction of damaged housing after the disaster was critical and became a common goal shared by property owners, local businesses, and local governments. As such, various strategies, regulations, and plans were developed to speed the recovery process. However, the effects of these policies on the recovery process have rarely been discussed.

Taichung County, located in the central part of Taiwan, was severely damaged by the 921 earthquake. Among the 161 totally collapsed condominium communities, there were 55 condominium communities located in Taichung County. To understand the impact of the reconstruction plans on condominium housing recovery, Taichung County was selected as a case study to examine the correlation between polices and recovery speed. The establishment of condominium community reconstruction committees and the approval data of reconstruction building permits were selected to represent housing reconstruction speed.

Figure 2. Condominium Housing Reconstruction Policies and Reconstruction Speed



Among the 55 collapsed condominium communities, a total of 51 condominium communities established their URRCs; however, only 40 condominium communities received building permits. The correlation between condominium housing reconstruction plans and the two indicators are shown in Figure 2. Furthermore, the number of building permits started to rise after the ATP was issued.

Conclusion

The 921 earthquake was the most catastrophic disaster in Taiwan in the last century. After the earthquake struck Taiwan, planning for the impact area's recovery began almost immediately. However, neither the government nor the citizens had ever experienced such a devastating disaster and no recovery plans had been made prior to the disaster. As such, various new policies were promulgated to solve the vast number of problems emerging during the recovery process. Understandably, numerous contradictions arose among these plans and some had to be amended several times. After reviewing the dynamic changes of condominium reconstruction plans, some remarkable findings emerged and are listed below.

At the beginning of recovery, three factors caused slow recovery in condominium community reconstruction. First, the limited finances of most victims made them ineligible for government loans. The complicated UR procedure created a major obstacle. In addition, uncertain political circumstances slowed recovery speed because the old government suspended action prior to the elections and the new government needed time to become familiar with the operations of post-disaster reconstruction.

For those seeking to rebuild, private savings were their major financial resource for funding housing since most affected households didn't have any earthquake insurance. A guiding principle behind the government's recovery policy was that housing recovery should be market-driven. On the contrary, the 921 ERF with an NGO basis supplemented government insufficiency in the recovery phase. This unique partnership made a major contribution to the implementation of condominium recovery.

Notes

[1] In Taiwan, a "condominium community" is usually made up of one or several condominium buildings clustered in a site.
[2] It was the first time that the Democratic Progressive Party (DPP) became the ruling party.

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Hazards Education by Geographers: A Decade of Change

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Abstract

Research that physical and social scientists conduct about natural hazards and disasters not only expands our knowledge about various geophysical hazards and the human response to such threats, but it also shapes the manner in which students are educated. This paper focuses upon the teaching by geographers of college classes devoted entirely to hazards. It discusses both the content of the hazards courses and the background of the instructors, and it explores the relationship between the instructors' personal involvement in the arena of hazards research and the characteristics of their hazards courses. Those geographers who are actively engaged in hazards research, shown by the topics of their graduate theses and dissertations, their publication of journal articles reporting hazards research, their presentation of papers describing hazards at national professional meetings, and their subscribing to the Natural Hazards Observer, significantly differ in their approaches to teaching hazards geography coursework from other instructors.

Key Words: hazards education, hazards geography, hazards research

Research that physical and social scientists conduct about natural hazards and disasters not only expands our knowledge about various geophysical hazards and the human response to such threats, but it also shapes the manner in which students are educated. This paper describes what geographers teach in college classes devoted entirely to hazards. It discusses both the content of the courses and the background of the instructors, and it explores the relationship between the instructors' personal involvement in the arena of hazards research and the characteristics of their courses.

Data were gathered earlier this year from a survey of geographers teaching hazards courses at colleges and universities throughout the United States and Canada. Responses were received from 106 geographers, representing a response rate of slightly more than 70%. The eight-page questionnaire expanded upon a survey conducted in 1997 (Cross 2000). The 2007 survey sought information regarding the topical content of hazards courses, the targeted audience for their courses, and the professional background of the instructors.

Not all hazards geography classes are the same, and their content and the type of information emphasized varies widely. For example, 8% are taught at the freshman level, while 35% are taught at either the senior level or as a dual undergraduate-graduate level course. Twenty percent of the courses are taught every semester, while 28% are taught either every other year or occasionally. Those taught at the freshman or sophomore level are mostly taught either every semester or every year, while the norm for junior-, senior-, and dual-level hazards courses is to be taught annually or every other year.

Typically, the higher the class level, the greater the proportion of class time that is devoted to social science aspects of hazards. The amount of class time devoted to physical science aspects of hazards, relative to the time devoted to social science aspects, has changed little over the past decade, and this physical science emphasis distinguishes most of the lower-level classes from the upper-level hazards courses. The type of hazard that receives the greatest amount of classroom attention also varies with the course level, with fewer higher-level courses emphasizing earthquake hazards, being more likely to highlight flood hazards.

The length of time discussing most types of hazards changed little between 1997 and 2007. One of the exceptions is the time spent discussing wildfire hazards, which had significantly increased by the 2007 survey. In general, those natural hazards (windstorm, flood, and earthquake) that received the most attention in 1997 also did so in 2007.

Changes in the time devoted to various social science aspects of hazards were generally relatively small and not statistically significant. Nevertheless, small increases were reported in the discussion of hazard perception, vulnerability and political economy, hazard warning systems, and disaster planning and management. When asked which of these topics were given the greatest amount of class time, noticeable increases in the proportion citing vulnerability and political economy and hazard warning systems were seen in 2007, while the proportion citing hazard zoning and land use planning dropped by half.

Although various models or paradigms describing human response to natural hazards have been proposed, the discussion of these models within hazards geography courses has fallen. A decade ago, one quarter of the instructors mentioned none of the models; that figure has now risen to 38%. While the work of the late Gilbert White is still the most widely discussed, now it is mentioned by only half of the instructors, down from nearly three quarters. Robert Kates' Adjustment Process Control Model is now less often mentioned, while that of Piers Blaikie and Ben Wisner is more frequently cited, yet still by under a third of instructors. While it might be argued that some of the models listed had become dated, the 2007 survey included one more option than the previous survey, adding recent work of David Alexander yet an increased number of instructors discussed none of the models. Instructors emphasizing physical science aspects of hazards are less likely to discuss models of adjustment behavior, yet one-fifth of those devoting at least half of their class time to social science aspects ignored all of the models.

When asked, "Do you use [various hazards maps] in your teaching?" a greater proportion of the instructors responded affirmatively in 2007. The proportion using FEMA's Flood Insurance Rate Maps of their local area in their teaching rose from 37% to 46%, while those using the U.S. Geological Survey's geologic hazards maps rose from 50% to 74%. Instructors devoting at least half of their class time to social science aspects of hazards were significantly more likely to utilize local flood maps than were instructors spending the majority of class time on physical science aspects of hazards.

Instructors were asked whether Hurricane Katrina influenced their hazards courses. Fifty-nine percent responded that Hurricane Katrina prompted them to alter their classes. A large variety of changes occurred—including increasing the frequency of the scheduling of the course, but alteration of course content was focused into four broad categories: expanded hurricane coverage, case study of disaster management, increased concentration on social issues, and changed or increased emphasis on megacities.

While 52% of the instructors of hazards geography classes had written either their doctoral dissertation or master's thesis on some aspect of natural or technological hazards, many instructors were far less involved with hazards research. Forty-four percent had never presented a paper at a national geographers meeting and 42% had not published any journal articles on a hazards topics. Individuals lacking an involvement with hazards research teach hazards courses that significantly differ in their approaches and content—including the selection of the course textbooks. The most frequently adopted textbook (Patrick Abbott's "Natural Disasters") is used by 45% of instructors whose graduate studies lie outside of hazards, but by only one-sixth of writers of hazards theses or dissertations. Hazards graduates most commonly adopted Keith Smith's "Environmental Hazards," with their second most commonly selected textbook (Tobin and Montz's "Natural Hazards") being entirely avoided by those whose theses and dissertations were not on hazards topics.

Many newcomers now teach hazards geography. Two-thirds of the 2007 survey respondents did not teach hazards a decade ago. The newcomers are slightly less likely to have written a graduate thesis or dissertation on a hazards topic than those instructors who have taught hazards courses for at least a decade, but they are significantly less likely to have presented a hazards paper at a national geographers' conference or published an article on a hazards topic in a peer-reviewed journal. The amount of class time devoted to many topics, particularly regarding human response to hazards, is significantly related to the instructor's involvement with both hazards research and the hazards community, whether measured by their thesis or doctoral dissertation topic, their presentation or publication of hazards papers, their membership in the American Association of Geographers Hazards Specialty Group, or in particular, their subscription to the *Natural Hazards Observer.*

Other than typically devoting more class time to discussion of social science aspects of hazards, the background of the instructors had a relatively minor impact upon the types of natural hazards discussed. Instructors with a hazard research background were more likely to indicate that floods were the hazard with which they devoted the most class time, while other instructors more commonly indicated windstorm or seismic hazards.

The biggest impacts of the instructors' background can be seen in their discussion of various hazard response topics. Individuals who wrote hazards theses or dissertations were significantly more likely to describe a variety of hazards response models or paradigms in their classes. Indeed, 56% of those lacking a hazards research background mentioned none within their classes, while 51% of those whose research focused on hazards mentioned three or more such models. Instructors who wrote a hazards thesis or dissertation are more likely to devote more than three hours of class time to the discussion of "vulnerability and political economy" and less likely to devote that much time to "structural adjustments (engineering works)." An even stronger set of relationships exist between the discussion of various hazards topics and whether or not the instructor has a subscription to the *Natural Hazards Observer.* For example, *Observer* subscribers were three times as likely to devote more than three hours discussing models of adjustment behavior, and nearly twice as likely to spend that much time discussing hazard perception, vulnerability and political economy, and flood insurance.

What we do in the hazards research community informs and influences our teaching. Based upon my survey of geography courses about hazards, the research activities of the instructors considerably influence the type of information about hazards that geographers convey to their students. Yet many courses, particularly at the lower level, which enroll the most students, are taught by instructors without this connection to the hazards research community, and what is included in those classes varies significantly from what others teach.

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A Dynamic Model of Household Hurricane Evacuations

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Abstract

This paper addresses a limitation to existing hurricane evacuation modeling aspects by developing a dynamic model of hurricane evacuation behavior. A household's evacuation decision is framed as an optimal stopping problem where every potential evacuation time period prior to the actual hurricane landfall, the household's optimal choice is to either evacuate or to wait one more time period for a revised hurricane forecast. We build a realistic multi-period model of evacuation that incorporates actual forecast and evacuation cost data for our designated Gulf of Mexico region. Results from our multi-period model are calibrated with existing evacuation timing data from a number of hurricanes. Given the calibrated dynamic framework, a number of policy questions that plausibly affect the timing of household evacuations are analyzed, and a deeper understanding of existing empirical outcomes in regard to the timing of the evacuation decision is achieved.

Introduction

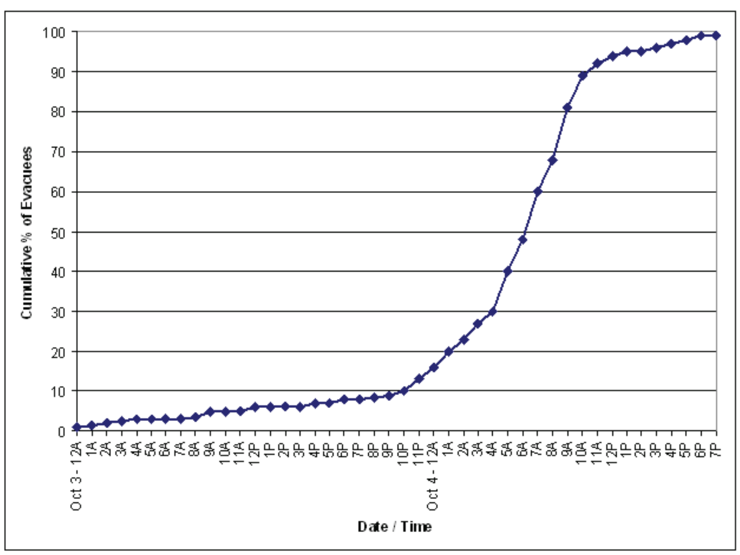
In their overview of social science research needs related to hurricane forecasts and warnings following the 2005 hurricane season, the most active hurricane season on record, Gladwin et al. (2005) highlight the need for research that leads to "… modeling of evacuation behavioral response in more precise and comprehensive ways," including the incorporation of the dynamic nature of evacuation decision making. The purpose of this paper is to respond to this call by developing a dynamic model of hurricane evacuation behavior. Specifically, a household's evacuation decision is framed as an optimal stopping problem where every potential evacuation time period prior to the actual hurricane landfall, the household's optimal choice is either to evacuate or to wait one more time period for a revised hurricane forecast. We build a realistic multi-period model of evacuation that is calibrated using existing forecast and evacuation cost data for a specific region, coastal areas on the Gulf of Mexico. We show that the model does a good job of explaining actual evacuation behavior in specific hurricanes, as well as expected evacuation timing outcomes by various household types. From this calibrated dynamic framework, a number of policy questions that plausibly affect the timing of household evacuations are analyzed.

Literature Review

Whitehead (2003) estimates the probability of evacuation for varying levels of hurricane intensity, but does so from a static perspective as the timing of the probability of an evacuation for any particular storm intensity level is not addressed. However, the evacuation decision when faced by a hurricane threat has the three qualities of irreversibility, uncertainty, and the ability to wait for more information that characterize a decision process that is better understood from a dynamic modeling approach (Dixit and Pindyck 1994). Standard empirical results from the evacuation literature, such as the traditional S-shaped evacuation response curves (an example from Hurricane Opal in 1995 is shown in Figure 1), indicate certain households wait while others evacuate, and therefore further underscore the need for a dynamic perspective of evacuation behavior.

Moreover, modeling the evacuation decision process dynamically over many time periods with households having the ability to wait for more information is analogous to a real-life evacuation decision situation where the National Hurricane Center

Figure 1. Hurricane Opal Cumulative Evacuation Response Curve



(Source: Adapted from USACE 2006)

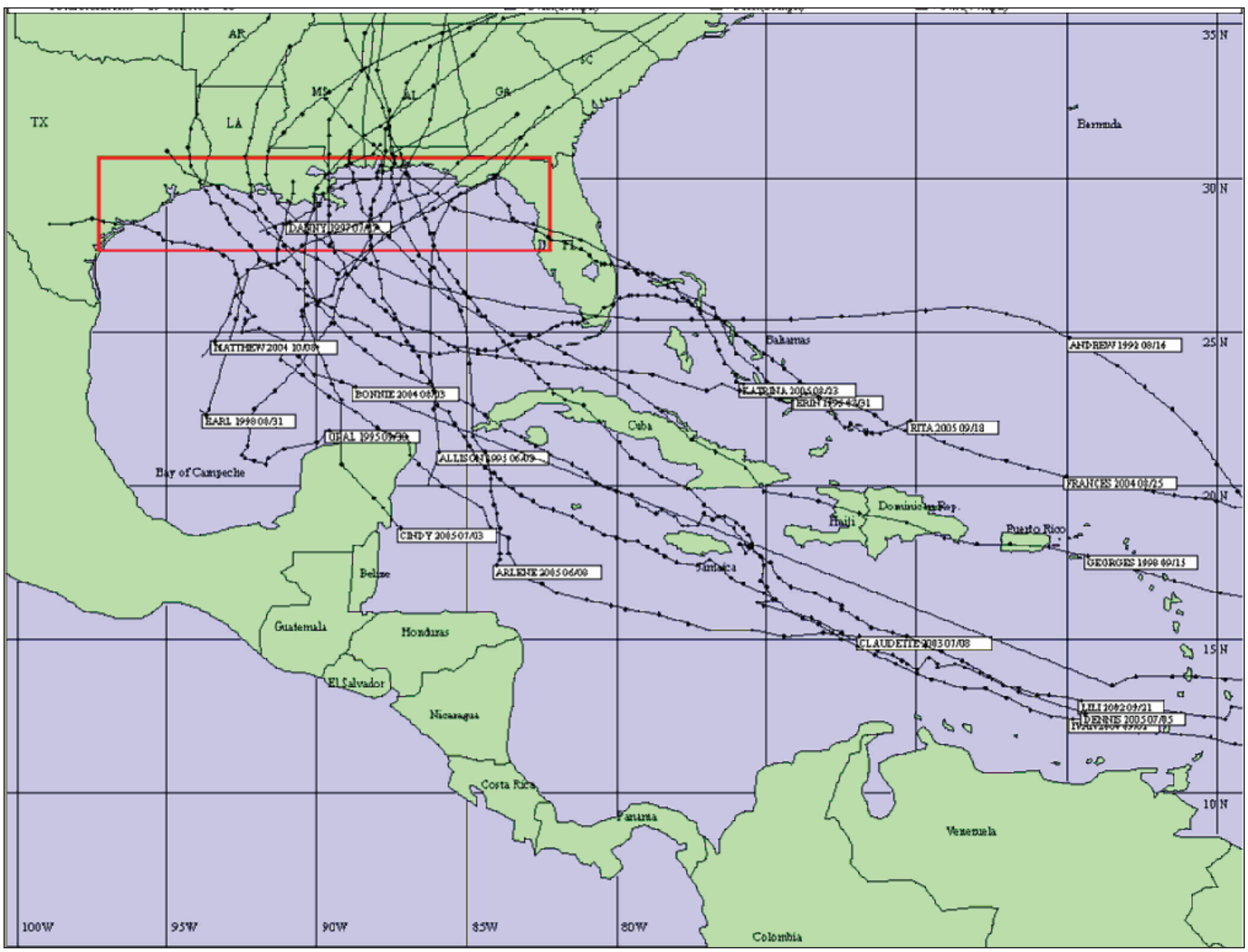
(NHC) issues official forecast advisories every six hours once a tropical depression, tropical storm, or hurricane has developed. While Fu and Wilmot (2004) utilize a sequential choice model to estimate the probability of a household evacuating or waiting in each period of their dynamic multi-period framework, and further use their dynamic model results to provide clarification to the standard evacuation timing empirical outcomes, their research differs from ours in a number of significant ways.

Importantly, we provide a theoretical model of dynamic evacuation behavior, which is necessary for conducting policy analysis. Furthermore, our dynamic model is calibrated with forecast data from a number of storms across a number of locations (see Figure 2), which coincides directly with the six-hour NHC forecast advisory timeline, and we explicitly address the costs of evacuation in a household's evacuation decision. This research then serves as a contrast to the existing models of hurricane evacuation behavior by utilizing a theoretically-driven dynamic modeling approach that provides a more realistic interpretation to the multi-period evacuation decision process through the use of forecast and evacuation cost data, thereby helping to further bridge the knowledge gap between hurricane forecasts and evacuation timing behaviors.

Methods

Once a tropical depression, tropical storm, or hurricane has developed, the NHC issues an official forecast advisory every six hours, at 5:00 a.m., 11:00 a.m., 5:00 p.m., and 11:00 p.m. Consequently, we can think of households potentially affected by the storm as being placed into a discrete time multi-period evacuation decision situation, where each discrete evacuation decision time period is six hours and is associated with a mutually exclusive NHC forecast advisory, denoted θ. We assume that a storm's

Figure 2. 19 Identified Gulf of Mexico Historical Storm Tracks



(Source: Adapted from USACE 2006)
(Note: Hurricane Charley is not included in this graphic)

landfall at time T is known with certainty,[1] and that the last safe possible time period for a household to evacuate, denoted by T*, is six hours prior to T. As the 120-hour forecast is the maximum forecast time issued, let n = 0, 1, …, 19 be the potential number of evacuation decision time periods from T* over the five-day forecast period such that we have (T*-19), (T*-18), …, (T*-1), T* potential evacuation decision time periods.

Let the (T*-n) current period forecast advisory, θ(T*-n), be a vector of j possible states that describe a household's current status as it affects its evacuation decision (Dixit and Pindyck 1994). At any (T*-n) current period the value of θ(T*-n) is known. However, hurricane forecasts contain a significant amount of uncertainty, with the degree of uncertainty decreasing as (T*-n) approaches T. For example, see the NHC annual average error track errors and the associated average error cone shown in Figures 3a and 3b respectively. Consequently, θ(T*-n) is a random variable that we assume follows a Markov process such that in the current period the probability that a particular realization of any of the possible j current states occurs, $\theta^{j}_{(T^{*}-n)}$, depends only on the state in the previous period.[2]

In each evacuation decision time period, households face the binary choice of either to evacuate or to wait one more time period for a revised hurricane forecast. If at any (T*-n) period the decision has been made to evacuate, this decision is not reversible as evacuation is assumed to be immediate and costs are sunk. For n = 1, ..., 19, the household evacuation decision in each (T*-n) period is either to evacuate immediately given $\theta_{(T^{*}-n)}$, or to wait one period for more information from the expected updated forecast of $[E_{(T^{*}-n)}(\theta_{(T^{*}-n-1)}) \mid \theta_{(T^{*}-n)}]$ and the possibility of evacuating during period (T*-n-1). For n = 0 the household evacuation decision in period T* is either to evacuate immediately given the now realized updated forecast of $\theta_{T^{*}}$, or to wait and simply ride out the storm at T.

Letting $V\{\theta_{(T^{*}-n)}, (T^{*}-n)\}$ denote the value at time (T*-n) of having a forecast of θ(T*-n), each household faces the following optimal stopping problem:

$$V\{\theta_{(T^{*}-n)},(T^{*}-n)\} = \min \{c_{EV(T^{*}-n)},\ E_{(T^{*}-n)}[V\{\theta_{(T^{*}-n-1)},(T^{*}-n-1)\} \mid \theta_{(T^{*}-n)}]\} \quad (1)$$

where

$$E_{(T^{*}-n)}[V\{\theta_{(T^{*}-n-1)},(T^{*}-n-1)\} \mid \theta_{(T^{*}-n)}] = \sum V\{\theta_{(T^{*}-n-1)},(T^{*}-n-1)\} p(\theta_{(T^{*}-n-1)}, (T^{*}-n)) \mid \theta_{(T^{*}-n)}$$

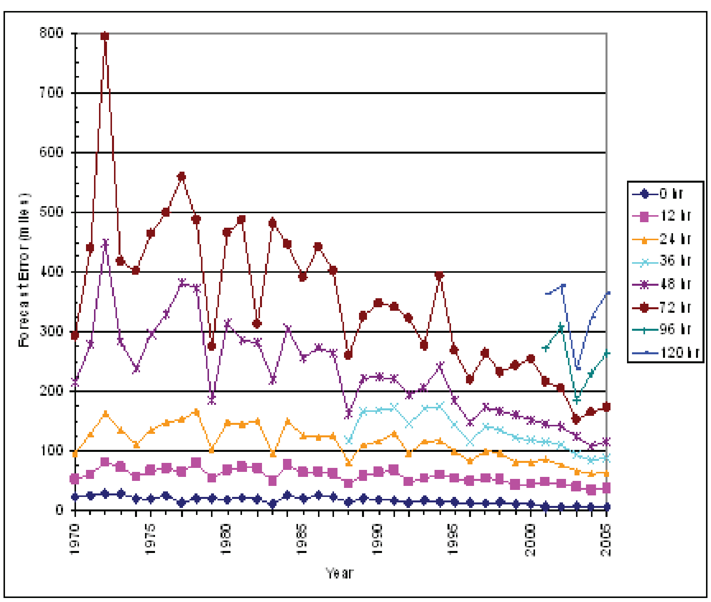
and

$$p(\theta_{(T^{*}-n-1)}, (T^{*}-n)) \mid \theta_{(T^{*}-n)}$$

is the distribution of next period's landfall forecast given this period's landfall forecast. Given the short time horizon, there is no discounting.

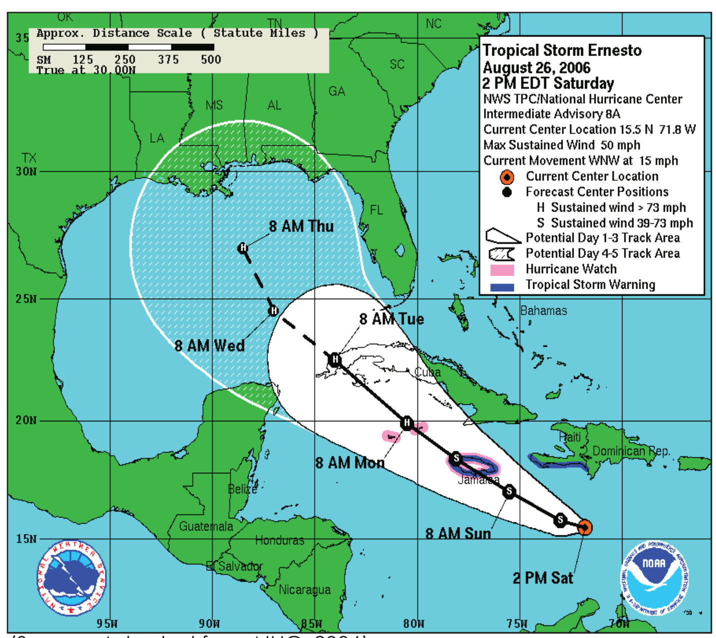
In order to solve this multi-period dynamic model of evacuation decision making, three main data inputs are needed: (1) for n = 0, 1, …, 19, vector of j possible forecast states, θ(T*-n), and their associated probability distributions, $p(\theta_{(T^{*}-n-1)} \mid \theta_{(T^{*}-n)},(T^{*}-n))$; (2) for n = 0, 1, …, 19, the costs of evacuation, $c_{EV(T^{*}-n)}$; and (3) for T, the expected costs of not evacuating, $c_{N\_EV(T)}$. For a detailed overview of the construction of these inputs, please see Czajkowski (2007).

Figure 3a. NHC Official Annual Average Track Errors, Atlantic Basin Storms



(Source: Adapted from NHC, 2006)

Figure 3b. NHC Average Error Cone Example



(Source: Adapted from NHC, 2006)

Findings

From our model setup we have a stochastic, finite-horizon, discrete time, discrete space, Markov decision model that is solved through backward recursion. Figure 4 presents the $\theta_{(T^*-n)}$ evacuation cut-off results for all (T*-n) periods, n = 0, 1, …, 11, along with the maximum risk index[3] determined for each of these periods. For periods T* to (T*-2) (i.e., within 1-day out from known landfall, we see that it is rational for an average household at a representative Gulf of Mexico location to evacuate when the forecasted hurricane risk index is > 1.0, and for period (T*-3) when > 0.75. This corresponds to the indicated evacuation region in Figure 4. However, for storms with risk indices < 1.0 in periods T* to (T*-2), < 0.75 in period (T*-3), and for any determined risk index values beyond period (T*-3) (i.e., two or more days out from known landfall) our model indicates that it is not rational to evacuate. This corresponds to the indicated waiting region of Figure 4.

While our results thus far have been general (i.e., for an average household at an representative location in our defined Gulf of Mexico region) we also evaluate how well our model does in explaining actual evacuation timing outcomes such as those from Hurricane Opal in Figure 1. Czajkowski (2007) specifically analyzes four storms for which we have evacuation timing information and whose forecast data were included in our probability transition matrices – Hurricanes Ivan, Opal, Charley, and Lili. The results from our general multi-period model applied to these actual evacuation timing behaviors for specific locations and specific storms indicate that our multi-period model does a good job of predicting evacuation timing outcomes for Gulf of Mexico locations. Given the illustrated precision of our model outcomes in regard to actual evacuation timing as well as expected evacuation response by various household types (see Czajkowski 2007), we feel comfortable in further using the model to assess potential hurricane related policies meant to affect evacuation timing.

Czajkowski (2007) provides a preliminary assessment of a number of potential hurricane policies meant to affect the timing of evacuation. For illustrative purposes we present an example of one such policy related to salaried vs. wage employees. The costs of evacuation used as an input for the solution of our multi-period model are comprised of four main components: direct, travel, travel time, and lost income. The costs of lost income are one component of evacuation costs that potentially can be targeted by policy makers as they are the largest component of our specified average costs of evacuation, and also delineate two separate household types for households that have someone in the household having to work – hourly vs. salaried worker household types. We assume that salaried workers have more flexibility in their decision to evacuate with any missed days of work not equating to lost income, while hourly workers have less flexibility in their evacuation decision assuming that they lose their income for any days missed.

The results from our multi-period model with the costs of lost income eliminated demonstrate a divergent salaried vs. hourly worker outcome as shown in Figure 5. When the costs of lost income no longer need to be considered in the evacuation decision, earlier evacuation two days out from landfall in periods (T*-4) to (T*-7) is shown to be optimal for certain risk indices where waiting had previously been optimal. The elimination of lost income costs from the evacuation decision makes it easier to evacuate earlier.

Figure 4. Average Household Optimal Evacuation Results

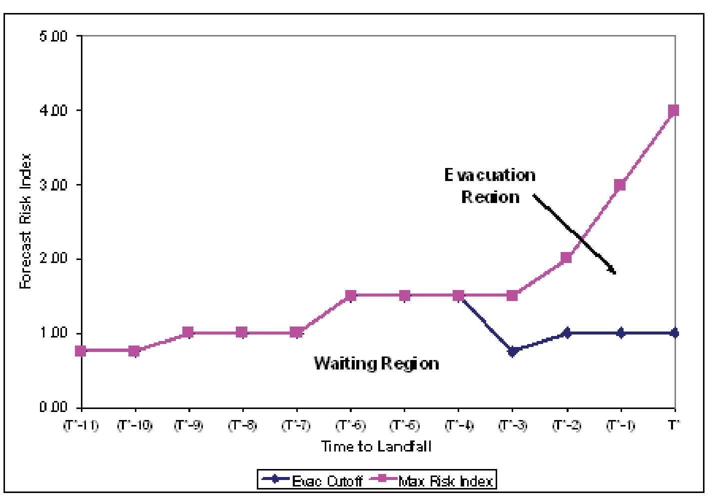
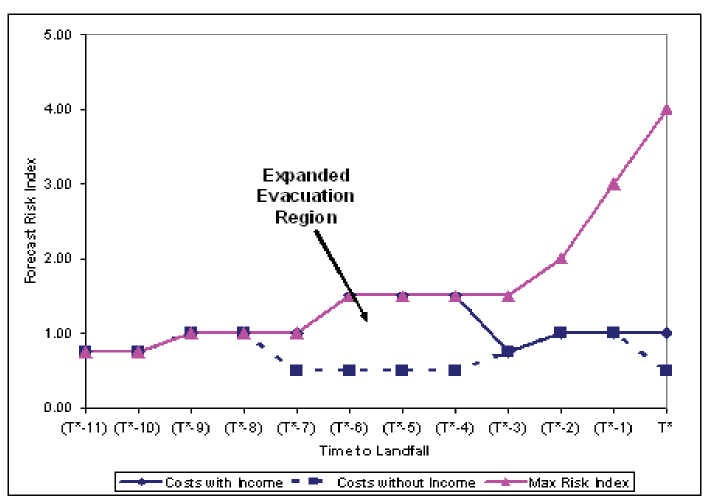


Figure 5. Optimal Evacuation Region Excluding Lost Income Costs



Notes

[1] Regnier (2006) shows that landfall timing uncertainty ranges from 8.8 to 11.5 hours. We do not introduce this additional level of complexity into our model at this time.

[2] For each pair of (i, j) states, the probability of moving from state i to j is . For all states in each period, a Markov probability transition matrix is utilized to summarize all the information about the probability of θ(T*-n) moving across states from one period to the next (Adda and Cooper 2003). Due to the inherent decreasing degree of uncertainty for θ(T*-n) as (T*-n) approaches T, our multi-period evacuation decision model uses Markov probability transition matrices that are nonstationary.

[3] In order to alleviate the dimensionality issues of the transition matrices, we construct a single discretized state variable which we call a hurricane forecast "risk index." The index combines the intensity and track forecast information into a scalar. See Czajkowski (2007) for a detailed presentation of the risk index rationale and construction.

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Disaster Deaths Research Challenges

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Abstract

This study is a first-order overview at consolidating limitations and gaps in disaster deaths research. Thirteen factors in four groupings are identified. Grouping A examines the definitional challenges of (1) disaster, (2) event, and (3) hazard and vulnerability classifications. Grouping B examines data to use in terms of (4) skewed statistics, (5) category choice, (6) prevented deaths, and (7) non-immediate deaths. Grouping C looks at people's behavior for (8) risk judgments, (9) risk-related actions, and (10) warnings. Grouping D focuses on the analysis of (11) the relative importance of factors, (12) death rates, and (13) the geographic distribution of deaths. Some disaster deaths data might not be collectable. However, not all policies to reduce disaster deaths might need complete data or detailed science to support their implementation. The main recommendation is that disaster deaths research should focus less on partitioning data and analyses by hazard and instead try to resolve vulnerability characteristics for reducing disaster deaths, irrespective of the hazard.

Key Words: casualties, deaths, mortality, research challenges, vulnerability

Disaster Deaths Research Challenges

Despite impressive and interdisciplinary work regarding the causes and circumstances of deaths from disasters, this field requires plenty of further research, particularly to ensure that policies and practices are based on robust and comparable evidence. This study is a first-order overview at consolidating research limitations and gaps in disaster deaths while seeking ways of overcoming the challenges. Literature examining deaths in specific disaster events was examined, which does not include the literature on loss of life modeling or disaster-related injuries. Events covered include astronomical phenomena (such as meteorites or comets striking or grazing Earth), avalanches, earthquakes, floods, heat and cold, landslides and related phenomena, lightning, storms (including cyclones and tornadoes), tsunamis, and volcanoes. Examples of other events to be considered are cold weather phenomena other than temperature (such as blizzards, freezing rain, and ice storms), disease, drought, hail, insect and other animal attacks (macrobiological hazards), wildfires, and wind. Thirteen factors in four groupings are identified for disaster deaths research challenges.

Grouping A: Definitional Challenges

1. Disaster. A particular difficulty is determining how to exclude deaths from non-disaster events since not all fatal events are disasters. An example is fifteen solo snowmobilers dying in fifteen separate avalanches compared to three neighboring families of five people each dying in the same avalanche. The definition of disaster affects which fatalities are considered when tallying avalanche disaster fatalities.
2. Event. Consistently defining start and stop times for disasters can be difficult. For example, lahars on Mount Pinatubo continued killing more than a decade after the 1991 eruption (e.g., Gaillard 2002). As well, aggregating and disaggregating events by geographical area, timeframe, and sequential versus simultaneous occurrences is often arbitrary. For instance, if one event hits multiple countries, some studies consider that to be multiple events (EM-DAT 2007).
3. Classifications. Hazard and vulnerability categories frequently overlap and are not always consistently defined. One database (EM-DAT 2007) labeled Bangladesh cyclones as wind storms even though studies state that most deaths were from drowning in the storm surge, so perhaps the event should have been labeled as a flood. Some earthquake-induced landslide deaths have been labeled as both earthquake deaths and as landslide deaths while tsunamis have many origins, yet their deaths are often pooled as tsunami deaths.

Grouping B: Data to Incorporate in Analyses

4. Events, small and large, can skew statistics in three ways. First, a single large event could radically alter long-term trends. The literature does not report any human deaths from a meteorite strike in recorded history, but a single large event could dwarf the total death toll from all disasters over the past millennium. Second, underreported small events have less influence on overall statistics

than they should have, which is termed "invisible disasters" problem (La Red et al. 2002). Third, hazard and vulnerability baselines are changing suggesting difficulties in establishing trends.

5. Similarly to factor (2), choices occur regarding how to classify some fatality data. For example, if a pregnant woman is killed, some jurisdictions count the fetus as a separate death (HCME 2005). Meanwhile, disaster deaths studies vary about whether or not they include homicides and suicides as disaster-related deaths. For storm deaths, some tolls include traffic crashes, yet others label those as traffic but not storm deaths as discussed by Jonkman and Kelman (2005). A similar discrepancy arises from crashes induced by wildfire smoke.
6. Deaths can be prevented due to a disaster event, such as fewer traffic crashes if people do not drive in a blizzard or if they stay indoors due to a hurricane. Should disaster deaths researchers calculate background rates of all "normal" deaths and add or subtract any differences following a disaster? Or should the focus be only to identify who is clearly killed in a disaster rather than worrying about overall rates? As well, some studies have noted that in the months and years following a major event, the background rate of deaths can decrease, because the disaster killed the most vulnerable members of the population who would have soon succumbed to "normal" death causes without the disaster. This observation has been termed "the harvesting effect" (e.g., Grattan 2005, 2006).
7. Non-immediate deaths from disaster-related physical or psychological complications can occur months or years after an event. This factor relates to the longer-term public health impacts of disasters, especially factor (2) regarding when an event stops.

Grouping C: Understanding People's Behavior

8. Judging and misjudging risks, including possible consequences, occurs prior to and during disasters, often influencing whether or not an individual is killed or survives.
9. Once a judgment is made regarding risks, the form of risk-taking or risk-avoiding actions influences fatalities, especially active versus passive risk taking or risk avoidance. An example is climbing an erupting volcano for photography or gas samples compared to poverty forcing people to live in slums on a volcano's slope.
10. Warnings are sometimes highlighted as being one of the most significant behavioral influences in disaster deaths, regarding how the possibilities for warning and responding to warnings influence the factors leading to death.

These factors have strong links and overlaps with many confounding factors including whether a disaster event kills directly or simply exposes chronic conditions that would have killed the same people anyway.

Grouping D: Data Analysis Approaches

11. The relative importance of factors analyzed can vary, especially the sensitivity of results to many of the issues raised here.
12. Rates of deaths (also termed mortality) might be more important for policy and practice than absolute numbers of deaths.
13. Geographic distributions of deaths should be further analyzed, both by comparing multiple scales and by comparing multiple locations.

Discussion

Strong connections occur amongst the different points, but no ranking of importance is implied in the order given above. Two main conclusions are that for disaster deaths research, basic methodological choices influence the results and that consistency is not always evident in studies. This conclusion, however, is not necessarily a consequence of inadequate research. In contrast, most studies are robust, needed, and helpful within the contexts which they define. Six main impediments to disaster deaths research are identified that explain the inconsistencies and the difficulties inherent in resolving the concerns, because some disaster deaths data might not be collectable:

1. Collecting detailed fatality data is not always a post-event priority.
2. Formal death records with all the information requested might not always be available.
3. Treating bodies and the bereaved with proper respect is important, and, in some situations, might preclude collecting desired data.
4. Disaster deaths data can be colored by political agendas that inflate numbers to attract help or that reduce numbers to avoid outside attention and intervention or to minimize compensation.
5. Determining the decision making process of each individual fatality—for example, understanding

how a warning was received (or not received) and acted upon (or not acted upon)—is challenging. Techniques for doing so are not always transferable across different event types or circumstances.

6. For establishing long-term trends, much data has been irreversibly lost.

Additionally, policies that are known—or just assumed—to be effective are often difficult to prove with research. For example, at least half of all flash flood deaths in the United States are said to occur in vehicles and the "Turn Around, Don't Drown" campaign is based on that premise (see http://tadd.weather.gov). Anecdotally, this campaign saves hundreds of lives each year—or more. But data on decision-making process, blood alcohol content, and vehicle type rarely appears in studies. Yet we know for certain that alcohol impairs judgment and reaction time, so do we really need to calculate the percentage of vehicle-based flash flood drownings who were drunk? Similarly, a debate raged in one journal regarding the safety of cars versus mobile homes in a tornado although extensive scientific data were not available.

Finally, after the research-related deaths of a dozen volcanologists in the early 1990's, Codes of Conduct were developed for volcano research (IAVCEI 1994, 1999). Research codes of conduct are a good idea, but given the small sample size of volcanologist deaths, it would be challenging to prove that the codes save lives. Is such proof relevant to implementing the codes of conduct? These examples suggest that certain aspects of disaster deaths might represent cases where policies and practices can be developed and implemented without solid scientific research or detailed data as a basis.

This information is useful for moving forward with disaster deaths research. In particular, accepting and admitting the severe limitations of disaster deaths data analysis, as many authors do, should be done all the time. That does not mean stopping the work, either the scientific publication or the policy influence. More cross-hazard work would be most important, rather than being isolated with one's preferred hazard. Additionally, more consistency might be possible in studies by sometimes using other authors' methods and spreadsheets rather than always inventing one's own for a specific study. That includes applying the papers that propose disaster deaths frameworks and seeing if common data collection methods and categories might be helpful across hazards. Overall, disaster deaths research should move away from the tendency to focus on hazard parameters and to compartmentalize research by hazards. Instead, disaster deaths researchers should focus more on resolving vulnerability characteristics, irrespective of the hazard.

Notes on References

This paper was written on the basis of approximately 100 publications, focusing on peer-reviewed journal articles and books at the exclusion of conference proceedings, dissertations, or unpublished work. About two dozen of the publications used were review papers or completed detailed literature reviews of their hazard-specific areas, describing and analyzing between a dozen and a hundred other references—and including conferences, dissertations, and unpublished work. Therefore, this paper covers approximately 700 disaster deaths references of all forms, approximately 15% directly and 85% by proxy. Due to length restrictions on and the large number of references used for this paper, these references are not provided in this document. Instead, references are listed and updated at www.ilankelman.org/disasterdeaths.html

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A Comparative Study of Single Family and Multifamily Housing Recovery Following 1992 Hurricane Andrew in Miami-Dade County, Florida

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Abstract

The topics of disaster recovery in general and housing recovery in particular have received relatively little attention in the disaster literature despite the importance of these issues (Drabek 1986; Mileti, Drabek, and Haas 1975; NRC 2006; Tierney, Lindell, and Perry 2001). This study brings a unique data set to bear on the important issue of permanent housing recovery that provides the opportunity to assess long-term recovery for three different forms of housing—single family, duplexes, and apartment buildings/complexes—following Hurricane Andrew, which struck southern sections of Miami-Dade County Florida in 1992. The findings suggest that duplexes and apartments have slower recovery trajectories than single-family housing. In addition, rental housing, housing with frequent sales, and housing located in predominately minority areas show significantly slower recovery speeds.

Introduction

Reestablishing permanent housing is a critical element in household and community recovery processes, but it is one of the least studied areas in disaster research (Tierney et al. 2001). The limited work discussing permanent housing recovery has suggested that different forms of housing will recover at different speeds. In particular, Comerio's (1998) work suggests multifamily housing will tend to have slower recovery speeds when compared to single-family housing, in part because redevelopment policies and post-disaster aid programs tend to target single-family, owner-occupied housing, neglecting other forms of housing (Comerio 1997, 1998; Peacock, Zhang, and Dash 2005; Wu and Lindell 2004). However, there exists no systematic quantitative research that compares housing recovery processes for different forms of housing and also seeks to control factors that may influence recovery trajectories. In order to provide a more comprehensive comparative assessment of the differences in housing recovery for different forms of housing, this study provides a multivariate analysis of long-term recovery for single-family housing, duplex, and apartment complexes in south Miami-Dade County, Florida, following Hurricane Andrew, which struck the area in 1992.

Literature Review

Researchers examining households and housing recovery in the United States tend to characterize the process as basically market driven or laissez faire, in that the government does not take an active direct role in the process, but rather depends on individual homeowners or businesses to rebuild housing, which draws on their own resources, insurance monies, and private capital to finance the process (Bates and Peacock 1987; Bolin 1985, 1993; Comerio 1998; Peacock and Ragsdale 1997; Quarantelli 1982). The government does offer funding through a variety of programs, such as the Federal Emergency Management Agency's (FEMA) individual and family grant and minimum home repair programs as well as a low-interest loan programs administered by the Small Business Administration, which, in Comerio's (1998) terms, act as a "safety net." Furthermore, as Comerio (1998) has also discussed, these programs generally target and are designed to address individual homeowners' needs, in part because of the general limitations and failures of recovery programs to address multifamily and rental properties. It is also partly due to the recognition of these shortcomings that in recent years there have been supplemental programs offered to communities and various housing agencies through the U.S. Department of Housing and Urban Development's (HUD) community block grants programs; however, these programs are more ad hoc, experimental, and limited (Bolin 1994; Comerio 1998; Peacock, Dash, and Zhang 2006; Peacock, Morrow, and Gladwin 1997).

Under the resource-contested circumstances emerging in the post disaster recovery situation, the disaster literature suggests that pre-disaster inequalities and normal market failure can be amplified (Bates 1982; Bates and Peacock 1987, 1989; Blaikie 1994; Bolin 1982, 1985; Haas, Kates, and Bowden 1977; Oliver-Smith 1990; Peacock et al. 2006; Quarantelli 1982). In general, low-income and minority households experience higher levels of damage and have fewer resources, both private and governmental, to aid in the recovery process (Bolin 1983, 1994; Bolin and Bolton 1986; Bolin and Stanford 1998; Peacock et al. 2006; Peacock and Girard 1997; Tierney 1997). In addition, minority and lower income neighborhoods often fall far short of receiving the necessary aid to jump start the recovery process, particularly for housing (Berke, Kartez, and Wenger 1993; Bolin and Stanford 1991; Bolin and Stanford 1998; Comerio 1998; Dash, Peacock, and Morrow 1997; Kamel and Loukaitou-Sideris 2004; Phillips 1993; Rubin 1985). Peacock and Girard (1997) for example, found that quality insurance companies do not underwrite coverage in areas with high concentrations of black households, often resulting in inadequate funding of rebuilding activities in these areas. In addition, Kamel and Loukaitou-Sideris (2004) and Dash et al. (1997) found that recovery in low-income neighborhoods and neighborhoods with high minority concentrations were further hindered by lower levels of governmental assistance relative to other neighborhoods that sustained similar damage.

An additional factor that has never been examined is the effect of post-disaster sales on housing recovery. Anecdotal evidence suggests that housing sales can become quite active in the impact areas following a natural disaster as was seen in the aftermath of Hurricane Andrew and, more recently, Hurricane Katrina. Sales may reflect abandonment as owners give up on a property, perhaps taking their insurance money and moving to other areas. Indeed, a natural disaster may reinforce the pre-disaster demographic trends as some victims relocate to other places that they may have been contemplating before the disaster (Girard and Peacock 1997). Home sales may also result from the lack of financial resources to repair or reconstruct the damaged homes, leaving households and properties open to speculators hoping to pick up properties at extremely low prices and either sell or repair them for later sales. Regardless of the reasons, the effect of home sales on the recovery process remains unknown, although we speculate that sales will, at least in the short term, result in a slow down in recovery.

Methods

The data used in this study were drawn from two major sources, the Miami-Dade County, Florida, tax appraisal data from 1992 to 1996 and the 1990 Census data at block group level. Tax appraisal data were merged to provide data on each folio throughout the five-year period and census data are linked spatially to each folio by using GIS. Because most of the heavily damaged structures were in southern sections of Miami-Dade County, only folios south of Kendall Drive (SW 88th Street) are included in this study. The final data set consists of 62,291 observations, which include 60,299 single family folios, 1,433 duplex folios, and 559 apartment complex/building folios.

As part of this research, several five-year (1992 to 1996) random effects panel models were developed

Table 1. Descriptive statistics of single-family housing, duplex, and apartment complex cases

Type	Single Family (N=60299)		Duplex (N=1433)		Apartment (N=559)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
1992 Building Value	63085	58201	40927	22100	641903	1855009
1993 Building Value	33933	52207	18428	22679	310779	1212983
Bedrooms	3.3	.7	4.1	1.0	49.5	121.9
Baths	2.0	.7	2.4	.7	40.1	103.1
Living Units	1	0	2	0	33.1	78.5
Owner Occupied	.89	.32	.27	.44	-	-
Md. Household Income in $1K	46.33	22.20	28.57	18.32	21.29	12.21
Prop. Non Hispanic White	.54	.235	.369	.269	.282	.243
Prop. Non Hispanic Black	.17	.230	.337	.340	.391	.349
Proportion of Hispanic	.27	.156	.279	.186	.316	.197
Building Age	24	12	29	13	31	14
Damage Proportion	.54	.37	.59	.34	.57	.36

predicting the log of the building/structure value (1992 to 1996). The explanatory variables include: a set of dummy variables for each year (1993-96), sales (number of sale for each year), tenure status (owner occupied = 1, renter occupied = 0), 1990 neighborhood median household income, 1990 neighborhood race/ethnic composition (non-Hispanic White, non-Hispanic Black, Hispanic, and other), damage, and a set of housing characteristics (number of bedrooms, number of bathrooms, and building/structure age) as controls. Descriptive statistics for many of these variables are presented in Table 1. Not surprisingly there are considerable differences in the value of structures, with single-family residences averaging $63,085, duplexes $40,927, and apartment complexes $641,903. However all had comparable losses ranging from 54% to 59%. Duplexes and apartments tended to be located in lower-income areas and in areas with higher concentrations of minorities. Single-family housing also tended to be slightly younger (24 years) when compared to duplexes (29 years) and apartment buildings/complexes (31 years). The vast majority of single family housing is owner occupied (89%) when compared to duplexes (27%).

Based on the literature, this study has five main hypotheses: (1) duplexes and apartment complexes will have slower recovery rates than single-family housing, (2) sales will slow the recovery process, (3) housing in lower income and (4) predominantly minority neighborhoods will have slower recovery rates, and finally, (5) renter-occupied structures will have slower recovery rates.

Findings

Table 2 displays examples of the models developed and analyzed as part of this research. The first three models are for single family, duplexes, and apartments and include the full complement of explanatory variables, with the exception of damage. The last three models include damage and a full complement of interaction terms between damage and year (1994-1996) dummy variables, which allow for the assessment of damage effects through time. The non-Hispanic White (Anglo) population is

Table 2. Selected model results

	Single Family		Duplex		Multifamily		Single Family		Duplex		Multifamily	
In building value	**Coef.**		**Coef.**		**Coef.**		**Coef.**		**Coef.**		**Coef.**	
Yr 93	-1.6557	a	-1.8718	a	-2.0359	a	0.7597	a	-1.8723	a	-2.0381	a
Yr 94	-0.1898	a	-0.7539	a	-0.9903	a	0.1991	a	-0.9700	a	-1.0794	a
Yr 95	-0.0344	a	-0.4887	a	-0.8000	a	0.1989	a	-1.2164	a	-0.8765	a
Yr 96	0.0564	a	-0.5599	a	-0.8140	a	0.2403	a	-1.2217	a	-0.9981	a
Bed room	0.1203	a	0.1706	a	0.0017		0.1293	a	0.1560	a	0.0044	
Bath room	0.4282	a	0.0474		0.0044		0.3350	a	0.0859	b	0.0016	
Building age	-0.0118	a	-0.0318	a	-0.0773	a	-0.0190	a	-0.0331	a	-0.0761	a
Ownership	0.3609	a	0.2609	a	-		0.2679	a	0.2995	a	-	
# of sales	-0.1461	a	-0.0906	b	-0.3888	a	-0.0386	a	-0.0857		-0.3681	a
Damage							-4.5070	a	-2.4288	a	-2.2860	a
Yr94 damage							3.7830	a	0.3610	a	0.1552	
Yr95 damage							4.0679	a	1.2252	a	0.1318	
Yr96 damage							4.1610	a	1.1150	a	0.3239	
Med hh income	0.0089	a	0.0156	a	0.0240	a	0.0045	a	0.0004		0.0112	
Prop. Black	-0.6616	a	-0.9323	a	-1.1702	a	-0.4788	a	-1.0493	a	-0.8318	b
Prop. Hispanic	-0.4184	a	0.8714	a	-0.2241		-0.5533	a	-0.1263		-0.3042	
Prop. other	1.5031	a	-9.7070	a	6.6918		-0.3441	b	-5.7234	b	13.6403	
Constant	9.3233	a	10.3236	a	13.6786	a	9.9815	a	12.4540	a	14.9990	a
R-sq: within	0.3496		0.1872		0.1426		0.6509		0.2031		0.1433	
Between	0.4210		0.2824		0.4924		0.6012		0.4321		0.5790	
Overall	0.3826		0.2380		0.3776		0.6277		0.3252		0.4360	

Notes: a $p \leq .05$, two-tailed; b $p \leq .05$, one-tailed excluded from these models, acting as a comparison for the other race/ethnic effects.

The findings suggest that duplexes and apartment buildings do indeed have slower recovery rates when compared to single-family housing. For example, the coefficient for the 1996 year dummy variable in the single-family model is positive indicating that the value of the structure has exceeded 1992 levels, suggesting that restoration/recovery levels are surpassed, after controlling for other factors, by 1996 (see model 1 and 3). In other words, these structures reached or surpassed their 1992 values by 1996, suggesting restoration levels had been reached. However, the coefficients for the 1996 year dummy in the duplex (see model 2 and 5) and apartment (see model 3 and 6) models are still negative indicating that restoration levels have not been reached even four years after the storm.

Not surprisingly, damage has major negative consequences among all forms of housing (see, for example, models 4-6). While the negative consequences of damage are higher initially for single-family housing (model 4), these effects attenuate dramatically by 1996. However, the effects of damage for duplexes and particularly apartments remain substantial throughout the entire period. The negative coefficients for sales suggest that sales have negative effects on recovery rates, although the negative effect is not significant in the duplex model after controlling for damage. Furthermore, after controlling for damage the consequences of income disappear except in the single-family model, where income has a small positive effect. The consequences of neighborhood minority concentrations display consistently negative effects across most models. In general, housing in minority areas exhibited slower recovery rates. This slow down was evident with respect to both Hispanic and non-Hispanic Black populations for single family homes but was most pronounced for housing located in more segregated non-Hispanic Black areas in both the duplex and apartment models.

Conclusions and Discussions

The results of this study provide the first quantitative multivariate evidence that duplexes and apartments have slower recovery rates when compared to single-family housing. In short, housing type does make a difference, with apartment complexes and duplexes displaying much slower recovery trajectories than single-family housing. The findings also suggest that these slow downs become more pronounced with increased sales and are particularly evident in areas with higher concentrations of minority populations, especially non-Hispanic Black populations.

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The Peril of Weak Property Rights in the Face of Natural Disasters

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Abstract

The role of institutions in the development process has received extensive attention in the economics literature. One aspect of this is the notion that economic actors under-invest in "their" properties when property rights are weak. In this study, we evaluate whether the weakened incentive to invest and maintain property due to weak property rights leads to an increased death toll when natural disasters strike. To test this, we consider 368 major quakes occurring between 1975 and 2004. Within the context of a standard model of earthquake fatalities, we show that a one standard deviation weakening of property rights in a country is associated with a 37% increase in deaths from a given quake.

Introduction

The notion that individuals and families are less likely to invest in and maintain "their" property when ownership claims are relatively weak has a long and well-accepted history in political economy, going back at least to Demsetz (1967). The impact of relatively weak property rights is both multi-faceted and somewhat obvious (see, for examples, North and Thomas 1973; De Long and Shleifer 1993; and Acemoglu and Johnson 2005). Examples of the deleterious effects at the household level include, but are not limited to: (1) less investment/maintenance in homes and other structures that necessarily deprive especially relatively poor "owners" from taking advantage of what is often their only potentially rising-value asset; (2) reduced ability to use the less-improved and poorly titled properties as collateral to access credit markets to fund either investments in their homes or businesses; (3) lost opportunities to acquire the "ownership culture" that is an essential ingredient in effective commerce, especially in an increasingly competitive global climate; and (4) reduced liquidity and thus transferability of their asset due to its poor titling. And in each case the negative intergenerational aspects of weak property rights simply compound.

A number of authors have considered this issue at the household/small enterprise level. Early in this literature, Besley (1995) showed that when operating in an environment of weak property rights, farmers rationally opt for land use practices that maximize short-run productivity at the risk of sustained development, a result that has been supported in Alston et al. (1996), Feder (1998), and Banerjee et al. (2002). Similarly, Jacoby, Guo, and Rozelle (2002) find that China's farm land reallocation program through which village leaders periodically rotate available plots between households tends to cause farmers to use significantly less organic fertilizers, which have a positive long-term effect on soil quality, in those villages where rotation, or expropriation, is practiced relatively aggressively.

More directly associated with the present analysis are a series of papers that are linked to the landmark book by de Soto (1989) that assess the natural experiment undertaken in Peru, which provided more than a million clear property titles to former squatters. In each of these analyses and given the nature of the property rights change, an attempt was made to identify the progressive aspects of enhanced property rights. That is, each addressed whether the enhanced property rights lead families to invest more in their property and whether the more secure titles gave families greater access to credit markets, the loans that could then be used to give the families a boast in developing their property as a means of combating poverty. Interestingly, the results of these studies are quite consistent: While each found enhanced investment in housing, typically this was paid for out-of-pocket as there was no consistent, significant improvement in access to credit markets due to the enhanced titling.

For example, Field (2005) reports, in urban slums, a two-thirds increase in the rate of housing renovation due to the enhanced property rights. Similarly, Galiani and Schargrodsky (2006), relying on actual architectural inspections of homes, conclude that the improved land titling lead to a 40% increase in the proportion of houses with good quality walls and a 47% increase in the proportion with good quality roofs. Using an overall metric of quality, they conclude that the enhanced property right was associated with a 37% overall improvement in housing quality. These results match up well with early surveys conducted by de Soto and the Instituto Libertad y Democracia of 37 settlements in Peru where it was found that the average value of buildings of those families who received clear titles to their property was nine times that of those who did not (de Soto 1989). Thus, while there is little doubt that strong property rights and the accompanying limited risk of expropriation leads to enhanced investment in one's homes, the jury is still out on the issue of whether such titling will eventually lead to greater access to credit markets, which is essential if strong property rights are to make its maximum contribution to reducing poverty.

The discussion above summarizes what we identified as the progressive aspects of providing enhanced property rights for households. In this study, rather than looking positively at the progressive aspects of enhanced property rights, we wish to consider the issue from the opposite perspective, focusing on the ill-effects facing households of weak property rights. Specifically, the brief summary above makes a case that strong property rights encourage investment in homes and other structures. The negative of this is also true—when property rights are weak, one can expect to find such investments severely limited. Were these investments merely cosmetic, while unfortunate for those involved, there would really be limited dire consequences for well-being. However, as the works noted above make clear, the lack of investment brought on by weak property rights leads directly to the construction and habitation of poorly built and maintained structures, which, no doubt, suffer greatly in the face of natural hazards such as wind storms, floods, hurricanes, and earthquakes. It is our contention that if weak property rights rationally lead "owners" to limit investments in their properties, fatalities from major natural disasters should be found to be worse in areas with relatively weak property rights, a contention that has to date not been formally tested. To test this proposition, we analyze 368 major earthquakes occurring worldwide between 1975 and 2004. We have chosen earthquakes as the example of natural hazard risk both because they are relatively common, providing for a reasonably large sample and, perhaps more importantly, because deaths from quakes result primarily from collapsing structures, which thus provides us with a relatively strong test of our contention. In preview of our results, after holding constant factors that prior research has shown to be strong determinants of the death toll from a given quake, we find a significant positive relation between relatively weak property rights and quake fatalities.

Data and Empirical Results

The source for the earthquake-related data is the National Geodetic Data Center's (NGDC) Significant Earthquake Database from which we take information on all quakes measuring 6+ on the Richter scale, occurring worldwide between 1975 and 2004, for which complete data is available. The focus on the number of lives lost—FATALITIES—allows us to avoid complications associated with estimating the costs of lost or damaged physical structures across countries and time. The sample includes 368 earthquakes arising from 42 countries with 9 being from Africa, 10 from Asia, 7 from Europe, and the remaining 16 from the Americas. We also take from NGDC two key variables that determine a quake's destructiveness: MAGNITUDE, measured by the common Richter scale, and proximity to the affected region or focal distance (DISTANCE). The death toll of a given quake should be greater for quakes that are more powerful and that occur close to population centers.

Our property rights variable (PROPERTY RIGHTS) is from the International Country Risk Guide (ICRG), published by Political Risk Services Group. This source reports complete data on more than 100 countries between 1982 and 2004 and takes on values of 1-10 with lower values pointing to the risk of "outright confiscation and forced nationalization of property." A negative coefficient on PROPERTY RIGHTS would be consistent with our contention.

We add controls for the destructiveness of earthquakes identified in previous analyses. First, we take into account the FREQUENCY with which a country suffers from a major quake by calculating the number of major quakes occurring in a country in the prior 100 years. If there is "learning by doing," FREQUENCY should be negatively associated with fatalities. We also consider the population and population density of the province(s) affected (POPULATION and POP DENSITY). For each, a positive relation with FATALITIES is expected. A country's level of development, measured by GDP per capita (GDP PER CAPITA) in constant 1995 U.S. dollars, as reported in the World Bank's World Development Indicators, is expected to be negatively related with the death toll from a given quake, given that greater levels of income should allow for higher-level building codes, better zoning and land use, and the like. Finally, to capture any region-specific factors, we include dummy variables for AFRICA, ASIA, and EUROPE relative to the Americas.

To conserve space, all summary statistics are available upon request. Here we only expressly note two, fatalities and property rights. The mean of FATALITIES is 796, with a broad range of 0-50,000. PROPERTY RIGHTS covers its entire range of 1-10 with a mean of 7.82, pointing to relatively secure property rights in much of the sample. To test the relation between property rights and fatalities due to earthquakes, we estimate the following model (where i references a specific country and each variable is as defined above.):

$$FATALITIES_i = \alpha_0 + \alpha_1 PROPERTY\ RIGHTS_i + \alpha_2 FREQUENCY_i + \alpha_3 DISTANCE_i + \alpha_4 MAGNITUDE_i + \alpha_5 POP\ DENSITY_i + \alpha_6 POPULATION_i + \alpha_7 GDP\ PERCAPITA_i + \alpha_8 AFRICA_i + \alpha_9 ASIA_i + \alpha_{10} EUROPE_i + \varepsilon_i \quad (1)$$

Since FATALITIES is rather dispersed, non-negative count data, we estimate Equation (1), as presented in Table 1, using a Negative Binomial specification that relaxes the Poisson's assumption of equal mean and variance by introducing a parameter (identified as α in Table 1) that explicitly accounts for unobserved heterogeneity. Prior to discussing the results for individual variables, we should note that diagnostics point to a relatively well-behaved model: (1) the parameter entered to control for unobserved heterogeneity, LR Chi-Square α, is significant well beyond the .001 level, (2) the full-model likelihood ratio Chi-Square test (LR Chi-Square FM) is also significant well beyond the 0.001 level, and (3) the model's maximum likelihood R-Square (ML R-Square) value of 0.361 is quiet respectable.

The variable of primary interest, PROPERTY RIGHTS, is both negative and highly significant, beyond the .01 level. This provides strong evidence that other relevant factors constant an earthquake can be expected to lead to significantly more fatalities in a country that has relatively weak property rights. Coupling this result with the positive effects of enhanced property rights on investment/maintenance in "owner-occupied" properties found in prior research brings the negative effects of weak property rights full circle. For example, architectural surveys of Galiani and Schargrodsky (2006) from Peru showed that enhanced property rights lead to an overall improvement in housing quality of nearly 40%. Our result is simply the reverse of the Peruvian experience with titling. When households have weak claims to the property they occupy, the resulting disincentive to invest in that property puts them at greater risk when a natural disaster such as a major earthquake strikes. In practical terms, the marginal effect of the property rights measure on fatalities, assuming all other variables are held at their mean

Table 1. LHMP status as of August 7, 2007.

Variable	(1)
Intercept	-23.04** (5.298)
PROPERTY RIGHTS	-1.79** (0.594)
FREQUENCY	-0.29 (0.236)
MAGNITUDE	20.34** (2.372)
DISTANCE	-1.15** (0.224)
POP DENSITY	0.22 (0.155)
POPULATION	-0.25* (0.149)
GDP PER CAPITA	-0.60** (0.174)
AFRICA	0.24 (0.736)
ASIA	0.93* (0.544)
EUROPE	2.47** (0.567)
LR Chi-Square (a)	82,00**
LR Chi-Square FM	164.54**
ML R-Square	0.361
Number of Observations	368

Note: Robust standard errors in parentheses.
** and * denote significance at 5% and 10%, respectively.

values, points to a 37% increase in fatalities for a one standard deviation weakening of property rights. Given the mean and standard deviation values of 7.82 and 2.33, respectively, for PROPERTY RIGHTS and the sample mean number of fatalities of 796, a fall in PROPERTY RIGHTS from the mean of 7.82 to 5.49 can be expected to increase deaths from a typical earthquake from 796 to 1,091. We take this to be a remarkably strong indictment of weak property rights.

The remaining variables, other than the continent dummies, all have the expected sign, though only MAGNITUDE, DISTANCE, POPULATION, and GDP PER CAPITA are statistically significant. Perhaps of most importance, GDP PER CAPITA is both negative and highly significant suggesting that the general process of development brings with it some degree of protection from the effects of natural disasters, as noted in Anbarci, Escaleras, and Register (2005). The regional dummies for both EUROPE and ASIA are positive and significant and while numerous factors might be at work, given our focus, we leave consideration of these to others.

Finally, to consider the sensitivity of our results, the model was re-estimated in two ways. First, we limited the sample to those 338 events with no more than 1,000 fatalities. Second, we used an alternative measure of property rights, the Index of Economic Freedom, taken from the Heritage Foundation in lieu of the ICRG measure. In each case, the results were not qualitatively different from those in Table 1.

Conclusion

The political economy literature has long argued the negative effects of weak property rights. Typically, however, these discussions, while thoughtful and thorough, have, to our minds, failed to cross the final logical bridge. That is, it is our contention that not only does the risk of expropriation lead to circumstances where "owners" of property rightly see little reason to invest in and maintain their properties, but this disincentive can and too often does prove deadly when natural disasters strike. We show this by analyzing 368 major earthquakes occurring in 42 countries around the world between 1975 and 2004. While controlling for those factors that others have shown to be important in determining a quake's destructiveness, we find, using one of the most common measures of property rights/risk of expropriation, that a one standard deviation increase in that risk leads to a tragic 37% increase in quake fatalities. Further, we confirm this result both by considering the possible effects of outliers and by using an alternative index of property rights. Were others to show similar results for other natural disasters, as would seem likely, the total cost of weak property rights in terms of lives lost would likely prove both stunning and most importantly, sadly avoidable.

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Analyzing Structural-Functional Dimensions of Public Participation in Earthquake-Stricken Region's Recovery: A Case Study of Iran's Lorestan Province

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Abstract

According to national and international organizations, Iran is one of the most disaster-prone countries in the world because of its special natural and geographical conditions. With regards to the several earthquakes that occur each year in the country, issues related to the stricken region's recovery and public participation in recovery plans are important and need to be considered. Realizing this matter and the extent of public participation in recovery process and their interaction with local and regional recovery authorities, it is one of the essential phases of future planning and decision making. According to this fact and because of the recovery's sensitive and organic nature, results that derived from public participation rates in different phases of recovery can be used as a positive feedback to improve recovery process in earthquake-stricken regions. In addition, this study has some secondary objectives, which include identifying negative and positive factors and components of public participation in recovery process; clarifying how and to what extent people have participated in recovery process in the Lorestan[1] case; and presenting strategies and methods for people participation enhancement.

Key Words: Public participation, recovery, recovery assistant agent

Introduction

The terms participation and participatory were used for the first time in late 1980s in developmental literature. Development based on public participation has increasingly been regarded as a key concept in developmental literature since late 1970s and early 1980s (Jennings 2000). The World Bank defines participation as a process through which stakeholders affect the acts, decisions, and take part in their control (World Bank 2002). Participation in reconstruction is a development-oriented voluntary and conscious process that includes the different strata of decision making, decision taking, implementation, evaluation, and revision to enable the people living in the earthquake-stricken area to speed up reconstruction along with the improvement of development indices of earthquake-stricken areas (Midgley et al. 2000).

In the first step, or more precisely, the decision making and decision taking stage, we can draw upon conferences, meetings, and seminars held between the public and local officials as manifest and concrete examples of public participation in the reconstruction process of earthquake-stricken areas (Harrison et al. 2001). In the implementation stage, participation through relief and rescue operations and self-initiated help could be regarded as part of the different stages. In the reconstruction stage, it can manifest in the form of cooperation and interaction with officials and administration of the reconstruction agents in earthquake-prone areas. In the last stage, people involved in the assessment and evaluation processes can cooperate and interact with the officials of reconstruction agents directly, whose responsibility it is to take into consideration the importance of these issues. This paper aims to scrutinize the how and why of public participation in reconstruction process of residential and commercial areas in earthquake-stricken areas of Lorestan province.

Review of Literature

As discussed earlier in regards to the public's participation in reconstruction process, we can posit three different stages, which include the decision making and decision taking (planning); the implementation stage; and the supervision, evaluation, and revision of plans. On the other hand, the main prerequisites of public participation in different stages of the reconstruction process involve several points. Before embarking on every action, it must be accepted that there are grounds for the public's participation. It is true to point out that the potentially increasing public participation in the reconstruction process already exists; however, planning for education, informing, and translating the public's potentialities into practice are needed. In addition, the potential benefits of public participation in the reconstruction process should outweigh its costs. Lastly, how the public will be involved must be crystal clear and appeal to the concerns of the people. As a result, the sustainability and continuation of participation is closely intertwined with public's interests and desires (Harrison et al. 2001).

Public participation in decision making and decision taking is in urgent need of participation-oriented management. In fact participation is meaningful when an individual has the possibility of selection freedom and free will to enter the action arena (Harrison et al. 2001). The following section takes into consideration the prerequisites that are necessary for public participation in the reconstruction process. We categorize the trends affecting the implementation and evaluation of prerequisites for public participation in reconstruction process into two categories (Harrison et al. 2001). The first, cognitive trend, reflects factors such as personality, alienation, social and cultural disempowerment, and general intrinsic and internal forces that are stressed.

The second is the behavioral trend (social psychology), which tries to disentangle the participation, factoring in every individual and his/her negligible social relations. In addition to these trends, there are two additional factors (conducive and impeding) that have an effect on public's participation. These are illustrated in Table 1 and Figure 1.

Methods

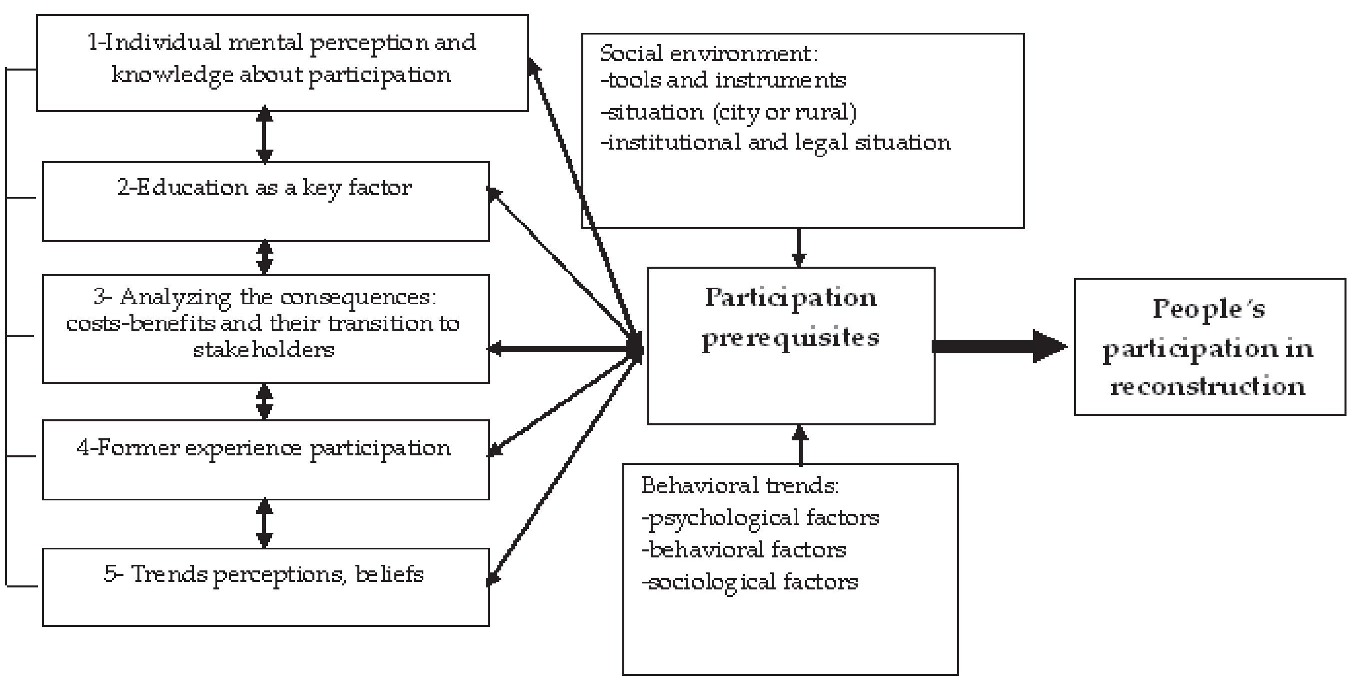
Much of the present research has been done through qualitative methods using interviews and participatory observation tools, which offer results that are descriptive in nature. In our case study, we focus on the public members of the Islamic rural council[2] of Lorestan's earthquake-stricken regions, who serve as the coordinating and reconstruction agents.

The methods used in this research include (1) periodic participatory observation of research group during the reconstruction time; (2) individual and group interviews with people, coordinating agents, reconstruction agents, Islamic rural and urban councils, and local experts of the Lorestan earthquake-stricken regions; (3) complementary studies (library and documents) for public participation in the reconstruction of the earthquake-stricken regions; and (4) gathering data and information through field work in 40 rural areas, using interview and participatory observation tools.

Findings

We found several considerations and discussions about public participation and the reconstruction process through full and effective interviews with local experts, councils, and reconstruction managers

Figure 1. Factors, Structures, and Efficient Variations to Public Participation in Reconstruction



Source: Harrison et al. 2001

and authorities. In first step of the reconstruction, including decision making, decision taking, and planning, Fars and Esfahan[3] for instance tried to use public participation in all phases, such as through policy making operating assessment and revision. Then, they held meetings with the public before preparing files and tasks. Fars and Esfahan believed that public participation would result in more obligations. The public helped experts in initial times by identifying homeowners because of their local knowledge of construction. Agents began to instruct them on the knowledge and technical information about reconstruction and construction management. Public participation in the third phase (supervising, assessment, and revision) with reconstruction time authorities included the necessary information about the degree of satisfaction with regards to the reconstruction trend. In addition, the public in some areas acted as its own supervisor and followed up on their dossiers themselves. The rural Darb Astaneh[4] is one of outstanding example of participation with Islamic rural councils and other authorities. In this region, the people transmitted their problems in each phase of the reconstruction to the rural council, who conveyed these problems to reconstruction authorities. This trend helped to accelerate the reconstruction process. These agents also engage in other actions such as calling for local contractors and so on. In some conditions in which it was necessary to relocate some rural areas, the area's mangers, after doing initial studies, held meetings with the public and Islamic rural councils. In some cases, they conveyed parts of the management to people directly. Generally, it can be said that in areas like Fars and Esfahan, the public had real participation in many affairs including contractor selection, selecting materials, distributing the materials, and selecting the type of their residential buildings.

Public Participation in Second Phase of Reconstruction Management

In the second phase of the reconstruction, the public effectively participated in some important tasks like material distribution, removing debris, putting walls up, and roofing. In general, it has been proven theoretically that public participation is one of the essential bases of reconstruction. Then, in reconstructing the earthquake-stricken regions, public participation in all levels is important, effective, and necessary, because the public is a main factor in the reconstruction process. Without them and their participation, interaction, and their direct cooperation, the reconstruction process in these earthquake-stricken regions would not have had the same speed and orientation. Most of the reconstruction areas in the Lorestan earthquake-stricken regions provided more attention to public participation, where they delivered the reconstructing management directly to people and acted as a conductor and supervisor. For example, the Fars and Esfahan areas, through using public participation in all aspects of the reconstruction process, completed their obligations on time and with higher quality than those who did not give attention to public participation. Areas that did not use public participation in first phrase of the reconstruction, because of failures in performing their obligations, were forced to use public participation in the latter phases.

Table 1. Factors, structures and efficient variables to people participation in reconstruction

Factor/variable	Conducive	Impelling
Traditionalism	•	
Trust in authorities		•
Fatalism		•
Family and racism	•	
Public dependency		•
High sympathy	•	
Lack of resources and economic disability		•
Trust in results		•
Enough knowledge and skills	•	
Communication skills	•	
Organizational networks	•	
Psychological preparations and optimism	•	
Self-sufficiency	•	
Accountability	•	
Good will in political or public system	•	
Career experience	•	
Source: Harrison et al. 2001		

For institutionalizing public participation in the reconstruction process and generally increasing public participation, the following recommendations might be helpful:

- With earthquake-stricken regions, consider the local culture, and economic and social characteristics.
- Provide public education and awareness through meetings, mass media, and brochures to increase

knowledge of participation in the reconstruction.
- Compile the unique rules and phases of the reconstruction.
- From the beginning of the reconstruction process, several meetings between local public reconstruction agents and council committees should be held to increase interaction between the public, reconstruction authorities, and mangers.
- Because of the multidimensional nature of reconstruction, planning and strategies should be flexible to show that interest in personal innovation will be helpful.
- Hold training and educational workshops before, during, and after reconstruction to provide necessary knowledge and techniques transition to managers, technical experts, and the public.
- The reconstruction pattern should be compatible.

Notes

[1] One of Iran's provinces

[2] Rural people's representations that act as an agent between people and government.

[3] Reconstruction agents.

[4] One of Lorestan's rural areas.

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Relationship between the Speed of Post-Disaster Condominium Housing Reconstruction and Household Characteristics

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Abstract

In the past, research primarily focused on single-family housing reconstruction after a disaster, but very few studies addressed condominium housing reconstruction. This study used Taichung County in Taiwan after the 921 earthquake in 1999 as a case study to determine if the speed of condominium housing reconstruction has a significant relationship to household income, but does not have a significant relationship to household size, race, age, marriage, or physical and mental obstacles. This research also found that the average reconstruction rate for condominiums was roughly two years longer than for single-family housing. It also became apparent that the longer household members stayed in the community and participated in the rebuilding, the quicker the reconstruction.

Key Words: condominium, housing reconstruction, post-disaster recovery, household characteristics

Introduction

Wu (2003), in his research on the Northridge Earthquake in 1994 and the 921 earthquake in 1999, found that the speed of condominium housing reconstruction was slower than that of single-family housing. Thus, condominium housing reconstruction has become a critical issue for post-disaster recovery in urban areas; however, very little research has focused on this type of reconstruction. Therefore, this study tried to determine if previous findings on single-family housing can be applied to condominium housing reconstruction.

Literature Review

Most past research on housing reconstruction focused on single-family housing and found that post-disaster housing reconstruction speed was influenced by household demographic characteristics such as household size, social economic status, gender, and race (Bolin and Bolton 1986; Tierney 1988; Bolin 1993; Bolin and Stanford 1998; Peacock et al. 1997). One feature of condominium housing indicates that having multiple property owners in a structure leads to collective decisions for reconstruction after a disaster. This explains why reconstruction is more complicated and closely related to the characteristic of the condominium "community." This phenomenon reflects previous research findings that showed that housing recovery was influenced by the culture, consensus, and unity of the communities before the disaster (Mileti et al. 1975; Oliver-Smith 1986). Considering previous research findings, this study has classified the influence factors for condominium reconstruction speed into two levels: "community" level and household level.

Methods

The 921 earthquake, with a magnitude of 7.3 on the Richter scale, caused the total collapse of 162 condominium buildings in 1999. Taichung County had the most damage with 55 collapsed condominiums. Among these 55 condominium "communities," 17 have not yet decided to rebuild, 3 adopted an Original Project Reconstruction approach, and the remaining 40 adopted an Urban Renewal Reconstruction (URR) approach. This study has chosen these 40 URR communities as the target population. These 40 URR communities had a total of 2,820 households with housing units ranging from 8 to 477.

This study used a quantitative research method by collecting related data from 2,820 households as well as performing a questionnaire survey among the URR communities' leaders in 2005. This study used the approval date of reconstruction building permits to represent housing reconstruction speed, and "community" characteristic[1] and households' demographic characteristics[2] as explanatory variables to identify the relationship between the speed of condominium housing reconstruction and selected characteristics.

Table 1. Community size and participating rate.

Household Number	Community Number	Average Participating Rate	Average Days to Get Rebuilding Permit
0 - 40	17	69 %	1,246
41 -100	14	52 %	1,302
101 - 200	8	44 %	1,330
200	1	55 %	905

Findings

The descriptive statistics showed that the average household number per community was 75. The average participating rate in rebuilding was 75% (see Table 1 for more detail). The average time for a condominium community to get a rebuilding permit was roughly 3.5 years, which was about two years longer than single-family housing in Taichung County. This study also used ANOVA, t-test, and Pearson correlation to analyze the data set. Table 2 shows the results.

The Macro View: Community Characteristics

This study found that the number of condominium owners in the community didn't affect the reconstruction speed. However, the higher the percentage of owners who chose to participate in rebuilding, the faster the reconstruction speed. This result may reflect the higher participation and greater unity of the community before the disaster. This also reflects Oliver-Smith's findings in Peru in 1986. This study also found that the personalities of the community leaders do not have a significant relationship to reconstruction speed, although the extroversion of a community leader had a significant relationship to the speed for establishing a formal community reconstruction committee—probably because an extroversive leader could easily involve community residents and persuade them to stay instead of moving out.

The Micro View: Household Demographic Characteristics

This study echoes the previous research on single-family housing that showed that victims' income is a critical issue related to housing reconstruction speed. Table 2 shows that the higher the household income both before and after disasters and the smaller the amount of income change, the quicker the reconstruction. However, this study found that housing reconstruction speed does not have a significant relationship to household size, race, age, marriage, or the presence of physical and mental obstacles.

Table 2. Relationship between reconstruction speed and explanatory variables

Variable	Analytical Methods	Statistic
Community Characteristics		
Community size (# of household)	Pearson Correlation	r = - 0.139
Participation rate of rebuilding	Pearson Correlation	r = - 0.454*
Characteristics of community leader		
-Agreeableness	Pearson Correlation	r = - 0.249
-Conscientiousness	Pearson Correlation	r = - 0.028
-Extraversion	Pearson Correlation	r = - 0.260
-Neuroticism	Pearson Correlation	r = - 0.007
-Openness to Experience	Pearson Correlation	r = 0.065
Household Demographic Characteristic		
Pre-income	Pearson Correlation	r = - 0.125**
Post-income	Pearson Correlation	r = - 0.160**
Changes of income	Pearson Correlation	r = - 0.035*
Age	ANOVA	F = 1.426
Race	t- Test	t = - 0.447
Household size	ANOVA	F = 1.277
Physical and mental obstacles	t-Test	t = 0.874
Marriage	t-Test	t = - 0.821

**p<0.01 *p<0.05 (two-tailed test)

Notes

[1] "Community characteristics" in this study refer to the community size, characteristics of community leader, and the participation rate of rebuilding.

[2] Household demographic characteristics in this study refer to household size, owners' race, income condition, age, and household size.

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Vulnerability of the Elderly during Natural Hazard Events

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Abstract

In this paper we analyze vulnerability of the elderly during natural hazard events at the macro level using the geographical distribution of the U.S. elderly population at the county level. The elderly population is defined as persons aged 65 years or older. We use data from the Spatial Hazard Events and Losses Database to identify counties with high frequencies of natural hazards events, such as hurricanes, from 1995 to 2005 and we identify characteristics of the elderly population in those counties. This analysis can be extended to other natural hazards. Future work will use regression modeling to incorporate socioeconomic variables such as poverty, race, and ethnicity to identify elderly populations that may be particularly vulnerable to natural hazards to be used as a guide for managing risks to vulnerable populations.

Key Words: vulnerable populations, elderly, natural hazards, hurricanes/tropical storms, infrastructure, transportation, public services

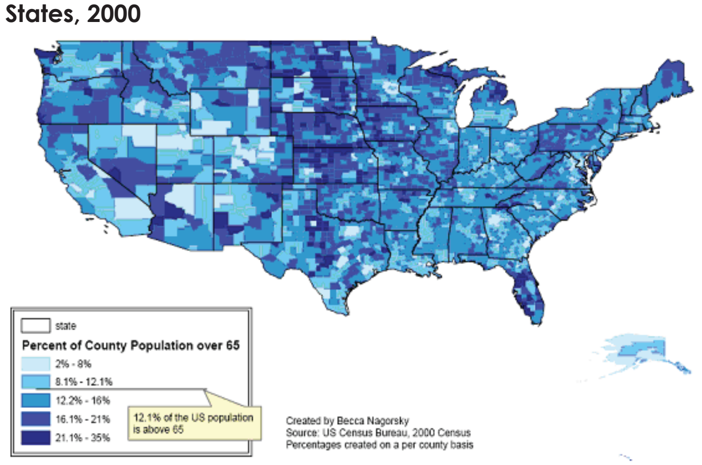
Introduction

The increase in natural hazards over at least the past few decades is well-known. Over the past 50 years alone, federally declared major disasters increased at about an estimated 2.7% per year (Simonoff, Restrepo, Zimmerman, and Naphtali 2007 forthcoming). Elderly populations, generally defined as persons 65 years old or older, have repeatedly been victims of these disasters, particularly vulnerable due to their relatively limited mobility, health status, and dependency on services such as electric power for cooling and life support systems, transportation, and communication. By July 2003, there were 35.9 million elderly people in the United States, constituting 12% of the U.S. population, and this percentage was expected to rise to about 20% by 2030 (He 2005). Figure 1 shows the concentration of the elderly in the U.S. for counties as a percentage of people aged 65 and over in each county. This research analyzes the spatial distribution of the elderly in the United States relative to the frequency and selected characteristics of natural hazards, such as hurricanes, to assess vulnerability of the elderly during these events and implications for their critical infrastructure service needs.

Literature Review

Previous studies indicate that the elderly have relatively fewer resources in terms of income than the rest of the population – 53.3% were low income according to the U.S. Department of Housing and Urban Development definition, compared to 28.6% of 16-64 year olds (Giuliano et al. 2003). Evidence, both anecdotal and statistical, points to the inability of the elderly to access transportation services during natural hazards, and their being victims of electricity and communication outages. An investigation into transportation services and the elderly indicates that most elderly drive, yet surveys reveal that if a natural disaster occurred, about 13% of persons 50-74 years old and 25% of those 75 years of age and older indicated needing evacuation assistance (Gibson and Hayunga 2006), and transportation services in disasters can be inadequate for needs of the elderly (U.S. GAO 2006). For electricity, during Hurricane Katrina, deaths occurred among

Figure 1. Geographical Distribution of the Elderly in the United States, 2000



the elderly in hospitals in which electricity failed. Electricity outage duration, particularly for weather-related outages, appears to be increasing (Simonoff, Restrepo, and Zimmerman 2007).

Methods

Geographic Information Systems (GIS) and statistical analyses of publicly available hazards, demographic, and public service usage data are conducted to establish relationships among these factors. Future research will include regression modeling to refine initial findings.

Findings

Our analyses of Census data to date indicate that although the elderly population is located in practically all of the more than 3,000 U.S. counties, half is highly concentrated in only 170 counties or about 5% of those counties. Similarly, our analysis of hurricane/tropical storm events (Hazards & Vulnerability Research Institute 2007a) indicates a geographic concentration of these events. The prevalence of hurricanes and tropical storms registered by the Federal Emergency Management Agency (FEMA) from 1995 to 2005 indicates that 471 counties (or about 15% of all counties) had at least one event, and these counties are concentrated in 17 states and the District of Columbia. Counties in only four states – Florida, North Carolina, Alabama, and Louisiana – have had 10 or more events from 1995-2005.

For this research we examine potential vulnerability of the elderly to natural disasters in different geographical areas. The analysis we present here is for hurricanes. We used U.S. data for 1995-2005 from the Spatial Hazard Events and Losses Database (Hazards & Vulnerability Research Institute 2007a). The correlation between number of elderly and storm frequency at the county level during 1995-2005 is low. It is .32 (1.0 signifies complete statistical correlation), but the relationship is positive. However, about 7.3 million elderly or a fifth of elderly people nationwide, reside in counties in which at least one hurricane or tropical storm occurred during this period. Florida in particular has relatively high concentrations of both elderly and storms.

We compared the 20 counties with the highest frequency of declared hurricanes during 1995-2005 (located in only three states: Florida, North Carolina, and Alabama) with the number and percentage of the elderly population in those counties and the Social Vulnerability Index (SoVI), which is an index computed using 42 socioeconomic and housing variables (Cutter et al. 2003; Hazards & Vulnerability Research Institute 2007b). This revealed that many counties with high numbers of elderly (generally above the national average) also have a very high SoVI.

Figure 2 shows the frequency of hurricanes (Hazards & Vulnerability Research Institute 2007a) on the x-axis and the percent elderly (U.S. Census Bureau 2005) for counties with at least one hurricane during 1995-2005 on the y-axis. The counties in the upper-right area of the figure represent areas of high vulnerability. Vulnerability in those areas would be compounded if the elderly populations also have a high percentage of poverty. Similarly, Figure 3 shows

Figure 2. Frequency of hurricanes by percent elderly

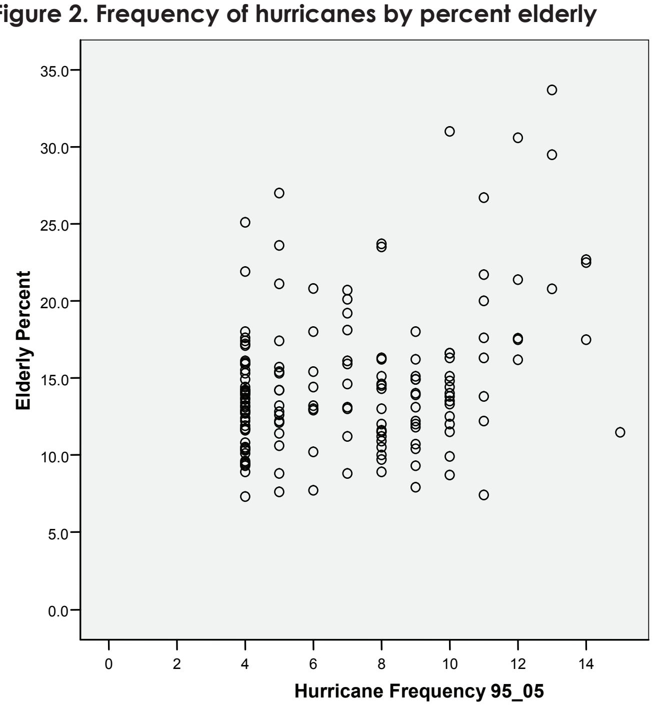
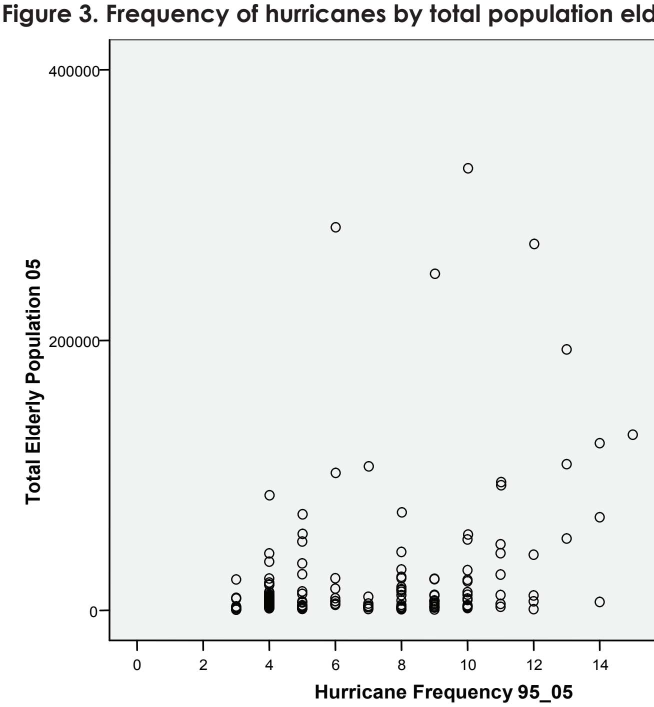


Figure 3. Frequency of hurricanes by total population elderly



the frequency of hurricanes on the x-axis and the total elderly population for counties with at least one hurricane during 1995-2005 on the y-axis.

Future research directions of this work include extending the analyses to heat incidents and other natural disasters and using statistical regression modeling to examine the vulnerability of the elderly by using various socioeconomic variables such as poverty, race, and ethnicity. In addition, we plan to examine vulnerability of the elderly by also examining the population 85 years of age and older.

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