The Intersection of Geoscience and Policy: An Examination of Local Geologic Hazard Mitigation Plans and State Policies in the Western United States

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Introduction
In the U.S., the contiguous western coastal states of Oregon, Washington, and California are vulnerable to a broad range of natural hazards, including infrequent but potentially catastrophic seismic, tsunami, landslide, and volcanic events. It is not a matter of if these geologic disasters will occur, but simply when. The risk of a future earthquake and tsunami triggered by the subduction zone off the U.S. Pacific coast makes developing hazard resiliency within communities in the region a priority of the state and, by extension, local governments. Comprehensive hazard regulations and local plans are two type of mitigation strategies to achieve geologic hazard resiliency on the west coast through disaster loss reduction.

This study aims to explore the following question
1) What is the role of local and state regulatory policies in geohazard mitigation and risk reduction?
2) What factors explain the variability of the quality in state and local hazard plans?
3) What are proposed recommendations for improving existing geohazard mitigation policies in these states?

Background
The Disaster Mitigation Act of 2000 represented a turning point for natural hazard mitigation in the U.S. by requiring all states to prepare comprehensive mitigation plans (HMPs). However, federal funding and mitigation efforts focus on floods and earthquakes. For other geohazards, state and local governments are primarily dependent upon themselves (Comerio, 2004). This has resulted in wide variations in the quality, scope, and effectiveness of natural hazard mitigation on the west coast.

Natural Hazard Policy Milestones in WA, OR, and CA
<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Statute Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1933</td>
<td>CA</td>
<td>Field Act</td>
</tr>
<tr>
<td>1972</td>
<td>CA</td>
<td>Seismic Fault Zoning Act</td>
</tr>
<tr>
<td>1973</td>
<td>OR</td>
<td>Land Use Planning Act</td>
</tr>
<tr>
<td>1977</td>
<td>WA</td>
<td>Seismic Hazards Reduction Act</td>
</tr>
<tr>
<td>1991</td>
<td>WA</td>
<td>Growth Management Act</td>
</tr>
<tr>
<td>1993</td>
<td>WA, OR</td>
<td>State Seismic Building Codes Act</td>
</tr>
</tbody>
</table>

Figure 1. Sources: compiled by author

Findings
The comprehensiveness of state planning mandates greatly influences the consistency, quality, and implementation of local mitigation plans in these states. California’s mandate was implemented in 1997, while Oregon and Washington’s hazard mandates were implemented more recently, and Washington’s does not require a natural hazard element, two facts that partially explains their weaker local hazard plan components (Lyles et al., 2014).

According to Schwab (2004) several other factors contribute to variations in local plan and policy quality in these states:
- Available resources and funding
- State and local political complexities
- Precedent of past geologic hazard events
- Level of interorganizational coordination

Despite federal policy issues, decades of collaborative efforts by regional agencies, state and local governments has resulted in great progress for hazard policies in these three states (Figure 1).

Evaluating Mitigation Policies & Plans
Natural hazard plan quality is generally evaluated on three core components:
- Factual basis
- Goals
- Policies

Berke et al. (2012), and Lyles et al. (2014) evaluated state and local hazard mitigation plans following the DMA (2000). State scores were classified using standard deviations from the mean score for comparison purposes. Hazard plan quality varied greatly between the western coastal states (Figure 2).

Plan Quality Principle Scores for WA, CA, and OR (2014)
<table>
<thead>
<tr>
<th>Plan Principle</th>
<th>Washington</th>
<th>Oregon</th>
<th>California</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Fact base</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Policies</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Figure 2. Sources: adapted from Berke et al. (2012) & Lyles et al. (2014)

A primary influence on local plan quality is the consistency and enforcement of each state’s planning mandate. Burby et al. (1993) conducted an analysis of state planning mandate requirements for the U.S., and the consistency of western coastal state mandates varied widely despite sharing many of the same hazard risks.

State Mandated Consistency Requirements for Natural Hazards
<table>
<thead>
<tr>
<th>State and Year</th>
<th>Vertical Consistency (with goal and policy)</th>
<th>Horizontal Consistency (with adjacent governments)</th>
<th>Consistency in Implementation Regulations &amp; Infrastructure</th>
<th>Overall Comprehensiveness of Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>California 1937</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>High</td>
</tr>
<tr>
<td>Oregon 1973</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Low</td>
</tr>
<tr>
<td>Washington 1991</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Low</td>
</tr>
</tbody>
</table>

Figure 3. Source: compiled and adapted from Burby et al. (1993)

Discussion
Natural disaster management has historically focused on response and recovery actions, but the importance of proactive, pre-disaster actions is increasingly being recognized. A critical component of mitigation policies is the factual basis, which typically comes from risk assessments derived from hazard maps and vulnerability surveys.

In California, risk assessments are a primary source of geologic data from which policy goals and priorities are formulated, as a state with outsized seismic risks and frequent earthquakes. Similar seismic, landslide, and tsunami hazard maps have been prepared for urban areas of Washington and Oregon, but their use is purely advisory, and not mandated by state law (Comerio, 2004).

Washington and Oregon also have far fewer total hazard policies and legislation compared to California (Figure 4), due in part to the lack of precedent of geologic disaster events in the states, policy updates are generally motivated by learning experiences of past hazard events.

Figure 4. Source: USGS (2006)

Conclusions
Mitigation policies are the cornerstone of state natural hazard management and a cost-effective tool for geologic disaster planning in this region if executed correctly.

The effectiveness of local HMPs reflect the quality and enforcement of state mitigation policies. The quality of HMPs also depend upon the consensus of individual state planning mandates for specific geohazards. As demonstrated in California with seismic hazards and associated policies; increased coordination and planning efforts between state and local governments, in addition to greater state enforcement, are all key factors for improving natural hazard mitigation measures.

For Oregon and Washington, greater interorganizational collaboration is essential for creating high-quality mitigation policies, and by extension, effective local plans to address regional risks associated with rare geologic disasters such as tsunamis, in addition to more frequent hazards such as landslides.

The current hazard policy research suggests that state mitigation plans which emphasize pre-disaster policies have the potential to be the most effective for:
1. Minimizing geologic hazard related infrastructure and property losses
2. Reducing hazard vulnerabilities and improving community resilience for natural disaster response and recovery

Figure 5. Source: compiled by author

References

Burby, R. J., 2005, Have State Comprehensive Planning Mandates Reduced Insured Losses from Natural Disasters? Natural Hazards Review. 6(2), 67-81.

