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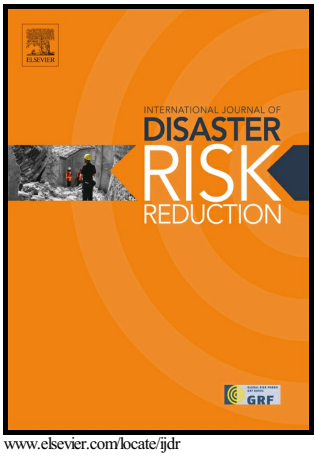

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Two-stage Approach to Quantify the Resilience of Maritime Hazardous and Noxious Substance Spill Accidents

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Abstract

Disaster resilience has become an important agenda after the United Nations proposed the Hyogo Framework in 2005. In order to quantify disaster resilience, several assessment methods were proposed, yet there exists considerable disagreement about measuring and quantifying resilience. This study proposed a two-stage approach that adds disaster-specific indicators as part of an evaluation step to the Baseline Resilience Indicators for Community (BRIC) proposed by Cutter et al. (2010). Through a two-stage approach, we expected to improve the utilization and scalability of the assessment. As a case study, resilience scores responding to maritime hazardous noxious substance (HNS) spill accidents at 17 ports in Korea were evaluated. In consequence, Ulsan and Wando were rated the most and least resilient, respectively. Further, we employed a two-stage approach using linear regression analysis between average leakage amount, as a measure of actual accident damage, and the evaluated resilience scores of ports. These quantitative results can be easily decomposed into sub-indices and stages to provide a rationale for policymakers to efficiently distribute limited resources.

Keywords: *disaster resilience, two-stage approach, maritime HNS spill accident, sub-category, validation*

1. Introduction

Modern society depends more and more on highly networked systems of electricity, water, gas, oil, communications, building materials and other infrastructure. The complexity of networked systems causes cascading effects that can unexpectedly trigger massive failures of whole systems after an initial local event (Peter et al., 2008). Such complexity and uncertainty have made it difficult for disaster management systems to effectively respond when large-scale events occurred (Janssen et al., 2006). As needs for rapid response to unexpected events and for resilient communities have increased, there have been several efforts to construct frameworks of disaster resilience. For example, in 2005, the United Nations proposed the Hyogo Framework (UNISDR 2005), which identified ways to build resilient communities by (1) increasing local communities' capacity of prevention, damage mitigation, and recovery, (2) integrating such perspectives to construct sustainable disaster management policies, (3) designing emergency preparedness, risk reduction, and reconstruction programs in communities, and (4) implementing such programs.

1.1 Vulnerability, Resilience and Adaptive Capacity

The relationship among vulnerability, resilience, and adaptive capacity is not well established. According to Adger (2006) and Cutter (1996), vulnerability is defined as an inherent sensitivity to damage when a system is exposed to harm, while resilience is defined as a system's capacity to mitigate the potential consequences of disruption, hastening the recovery of damaged functionality to the original states. Resilience includes not just the measures of bouncing back, but those of bouncing forward (Adger et al., 2005; Folke 2006; Manyena et al., 2011). Some researchers have viewed resilience as a concept embedded within that of vulnerability (Manyena, 2006), while others have defined resilience as a separate concept but one often linked to vulnerability (Cutter et al., 2008a). Both vulnerability and resilience are dynamic but they need to be considered as static for measuring