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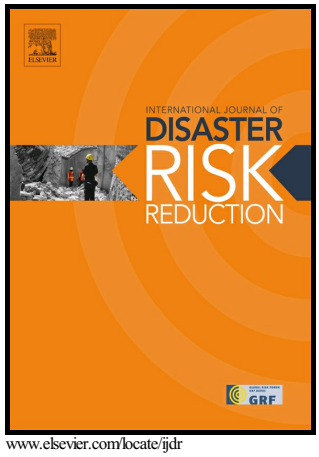

www.elsevier.com/locate/ijdr

PII: S2212-4209(17)30305-9
DOI: https://doi.org/10.1016/j.ijdrr.2017.10.015
Reference: IJDRR695

To appear in: *International Journal of Disaster Risk Reduction*

Received date: 16 May 2017
Revised date: 12 October 2017
Accepted date: 12 October 2017

Cite this article as: Behnam Vahdani, D. Veysmoradi, F. Noori and F. Mansour, Two-Stage Multi-Objective Location-Routing-Inventory Model for Humanitarian Logistics Network Design under Uncertainty, *International Journal of Disaster Risk Reduction,* https://doi.org/10.1016/j.ijdrr.2017.10.015

Two-Stage Multi-Objective Location-Routing-Inventory Model for Humanitarian Logistics Network Design under Uncertainty

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Abstract

The accidental and unpredictable nature of disasters such as earthquake brings about some plans to deal with critical problems in order to reduce the dangers at the time of their occurrence. Effective distribution of relief goods and supplies plays an important role in the rescue operation after an earthquake. Therefore, a two-phase, multi-objective mixed integer, multi-period and multi-commodity mathematical modeling in the three-level relief chain was offered, in which, locating of the distribution centers and warehouses with various levels of capacity, related decisions to the stored goods in the warehouses and established distribution centers were considered in the first phase, and considering the limited hard time windows, in the second phase, operational programming was performed for vehicle routing and distribution of goods to the affected areas, so minimizing the total cost and travel time also increased the reliability of the route. In addition to the features considered in this model, in special cases, it is possible that each critical area receives service more than once; to consider split delivery assumption in the problem, a different model will be presented for this purpose. Since some parameters are uncertain during the crisis, in order to let the model approach the reality, using a robust optimization approach, the model was developed in an uncertain condition.Two meta-heuristic algorithms of NSGAII and MOPSO were used to solve the given problem, in which the accuracy of the mathematical model and the proposed algorithms efficiency were assessed through numerical examples. The results of algorithms were presented for 35 various problems.

Keywords*:* relief distribution; locating-routing; inventory; time windows; multi-objective programming; meta-heuristic algorithms; robust optimization

1. Introduction

Crisis is a phenomenon which happens accidentally or naturally and imposes hardship and adversity to the human society. Occurrence of natural disasters and associated crisis indicate the importance of accurate programming to deal with its effects, thus, disaster relief logistics is one of the main activities in time of disaster. Earthquake, among fatal phenomena, causes widespread causalities and since their intensity is often extensive, the amount of demand to relief and rescue operations is very high and rapid distribution of essential facilities would be effective in the reduction of damages and death (Wang et al., 20014). Therefore, logistics programming and challenging in the crisis for the aid distribution are of extreme importance (Sheu, 2007). In a relief process, relief goods should be transferred to the affected areas directly from warehouses (the center of supplying essential goods) or through distribution centers. So, locating the warehouses and distribution centers in the vicinity of the affected areas and controlling and managing their inventory are important logistic strategies to improve the function and decrease time delay because the place and number of the distribution centers and warehouses and the amount of the aid

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