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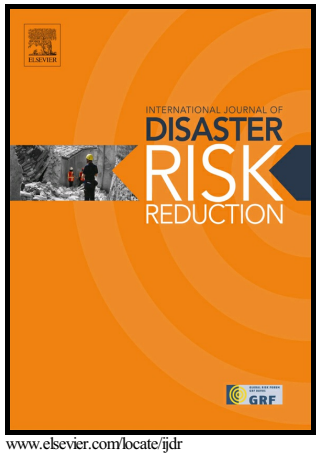

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Location and Allocation Optimization for Integrated Decisions on Post-Disaster Waste Supply Chain Management: On-site and Off-site Separation for Recyclable Materials

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Abstract

Post-disaster waste management is one of the most important operational management systems that have been developed to help affected communities recover and restore conditions back to a stable situation after a disaster. An effective post-disaster waste management strategy still needs to be further developed for optimum efficiency. Hence, this paper aims to present the developed system of post-disaster waste supply chain management strategy (PWSCM) along with the integrated decision-making system for the on-site and off-site separation of recyclable materials. A mathematical model of mixed-integer linear programming is proposed in which the objective aims are to minimize the financial effects through assessment of the fixed costs and variable costs, RSR (Reduction, Separation and Recycling) costs, and the penalty costs associated with the negative environmental and human effects of post-disaster scenarios and to maximize revenue from any sellable waste. The proposed model considers all networks in the debris operation process that consists of waste collection and separation sites, processing and recycling sites, disposal sites and market sites. Moreover, the RSR technologies have also been considered in the proposed model. Due to the limitations of competence of an exact solution method for such a large problem, this study also presents two effective metaheuristic approaches with particular encoding and decoding schemes; Particle Swarm Optimization (PSO) and Differential Evolution (DE) to solve PWSCM. Finally, the numerical tests for PWSCM improvement will be discussed. The performance of the proposed PWSCM improvement system was superior to both the on-site separation model and the off-site separation model.

Keywords: location-allocation optimization, post-disaster waste management, mathematical model, metaheuristic

1. Introduction

Disaster is any occurrence that causes damage, destruction, ecological disruption, loss of human life, human suffering, or the deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area [1]. Since the 1950s, the magnitude and number of disasters have exponentially increased, with the number of affected people having increased in proportion (about 235 million people per annum on average since the 1990s) [2]. In 2015, 376 naturally triggered disasters were recorded, with the economic damages estimated to be US$ 70.3 billion, resulting in the deaths of 22,765 people and seriously impacting 110.3 million victims [3]. Due to an increasing number of disasters, many researchers have paid a great deal of attention to the concept of “Disaster Management