Title	人道的救援ロジスティクスにおける施設配置ー割り当てモデルの研究
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Citation	
Issue Date	2021-03
Type	Thesis or Dissertation
Text version	ETD
URL	http://hdl.handle.net/10119/17465
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学 位 の 種 類	博士(知識科学)
学 位 記 番 号	博知第 280 号
学位授与年月日	令和 3 年 3 月 24 日
論 文 題 目	A Study on Facility Location-allocation Models for Humanitarian Relief Logistics
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論文の内容の要旨

Decision-making on shelter location-allocation is the most critical part of humanitarian relief logistics because it affects security of victims and influences the success of disaster management strategy. Without an appropriate approach for determining shelter location-allocation, decision-makers would make ad-hoc decisions which result in high cost, slow response, and failure to rescue the victims.

Proposing facility location-allocation models in the context of humanitarian logistics, monetary criterion cannot be ignored because it helps decision-makers to sufficiently prepare the grant aid for disaster relief purposes. In the same way, considering monetary and non-monetary criteria simultaneously helps to ensure that the victims are being taken care well under the optimal relief budget. Furthermore, the proposed models should be solved by proper approaches to generate optimal solutions. The victims and decisionmakers would get the benefit if the proposed models could simplify prompt decision-making for determining location-allocation in response to disasters.

This study aims to propose the optimization models to determine shelter location-allocation in response to disaster. In addition to the models, a novel approach for dealing with large scale location-allocation is proposed. Therein, four models are formulated to consider proper locations to use as shelters. The first model seeks to determine shelter location-allocation with total cost minimization. The proposed mathematical model is solved by Genetic Algorithm. The second model considers both monetary and non-monetary for justifying shelter location-allocation. The objectives of the model are to simultaneously minimize total cost, total evacuation time, and number of open shelters. The proposed mathematical model is solved by Epsilon Constraint method and Goal Programming which are the posteriori and priori methods respectively. The third model seeks to concurrently minimize total cost, and total evacuation time. The proposed model is solved by a novel approach that integrated Epsilon Constraint method and Artificial Neural Network to facilitate fast

decision-making. To the best of our knowledge, there are no existing works that combined these methods in coping with location-allocation problems, especially in field of humanitarian relief logistics. The fourth model involves multi-echelon relief facilities location-allocation. The first echelon determines appropriate shelter location-allocation to minimize total cost and minimize total evacuation time, while the second echelon involves justifying distribution center location-allocation to minimize distribution cost. The proposed model is solved by Epsilon Constraint method.

The applicability of the proposed models and proposed solution approach is validated through the case study of shelter location-allocation in response to flooding in Surat Thani, Thailand. The results generated by each model are compared with the current shelter location-allocation plan determined by the government sector. The comparison results indicate that considering appropriate shelter location-allocation based on proposed models mostly produces lower total cost than the current plan. It is plausible to use the proposed models and proposed solution approach to improve disaster response for the benefit of victims and decision-makers.

Keywords: Disaster Management, Epsilon Constraint Method, Genetic Algorithm, Goal Programming, Artificial Neural Network

論文審査の結果の要旨

When natural disasters occur frequently, it has severe impacts on humankind and economic systems across the world. When disaster strikes, the relief agencies typically dispatch the relief supplies to help and rescue the victims from the affected areas to the safe shelters. That is, decision-making on shelter location-allocation is one of the most critical parts of humanitarian relief logistics because it affects victims' security and influences the success of disaster management strategy. The principal aim of this research is to develop new models and solutions for solving the problem of shelter location-allocation in humanitarian relief logistics. The main contributions are summarized as follows.

There are four models for shelter location-allocation proposed in this research. The first model seeks to determine shelter location-allocation with total cost minimization, which is solved by Genetic Algorithm. The second model considers both monetary and non-monetary criteria for justifying shelter location-allocation with the objectives of simultaneously minimizing total cost, total evacuation time, and number of open shelters. This proposed mathematical model is solved by Epsilon Constraint method and Goal Programming. The third model seeks to concurrently minimize total cost and total evacuation time, and is solved by a novel approach that integrates Epsilon Constraint method and Artificial Neural Network to simplify fast decision-making on shelter location-allocation. Finally, the fourth model involves multi-echelon relief facilities location-allocation and is solved by Epsilon Constraint method. The first echelon determines appropriate shelter location-allocation to minimize total cost and total evacuation time, while the second echelon involves justifying distribution center location-allocation to minimize distribution cost. The applicability of the developed models and solutions is validated through the real-word case study of shelter location-allocation in response to flood in Surat Thani province of Thailand.

This dissertation has made good contributions both theoretically and practically in the area of humanitarian relief logistics. The research work presented in this dissertation has resulted in 2 journal papers and 2 refereed conference papers.

In summary, Ms. PRANEETPHOLKRANG Panchalee has completed all the requirements in the doctoral program of the School of Knowledge Science, JAIST and finished the examination on February 2, 2021, all committee members approved awarding her a doctoral degree in Knowledge Science.