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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This dissertation started with a broader aim of introducing the concept of temporary logistics hubs and its significance in post-disaster operation especially focusing on developing countries where preparedness lags behind actual needs. In doing so we studied different dimensions of temporary logistics hub (TLH) ranging from determining their location, allocation, timing of establishment, and ordering of establishment and developed models and methodologies for determining them. Furthermore, methodologies were also developed to enable evaluation of qualitative and quantitative attributes, and decision-making approaches which plays a vital role in enabling comprehensive analysis of multiple aspects of TLH location problem and its operational sustainability. The following sections summaries what has been achieved through this dissertation in retrospective to the objectives of this study.

One of the key decisions to make regarding TLHs is to determine and decide on where to locate them to achieve desired objective/s. Humanitarian operations often have more than one objective which necessitates use of multi-objective optimization. However, use of this approach requires knowing the weights assigned to different objectives which is often complicated. Furthermore, humanitarian response operations often requires engagement of wide range of actors ranging from government organizations to national and international non-governmental organization, and community organizations where the decision-makers have to make myriad of decisions under pressure and fuzziness while ensuring agility of relief chain. To address these issues we developed a multi-objective location model with the objectives of minimizing total cost and unsatisfied demand with multi-sourcing feature and a fuzzy factor rating system (FFRS) under group decision making (GDM) condition. The FFRS under GDM is used to determine the weight of objectives which is capable of accommodating decision-opinion of multiple decision-makers. The results of the numerical illustration using April 2015 Nepal earthquake shows trade off relationship between the two objectives and varying decision-opinion of different decision-makers when the decision-makers were considered homogeneous. Sensitivity analysis shows higher availability of emergency relief in the TLHs increases demand satisfaction at increased costs. Further, the analysis of the multi-sourcing constraint reveals the reduction in total unsatisfied.

Disaster response operations are often carried out immediately after its occurrence, during which time the information regarding precise values of the parameters is still evolving. The entire decision-making ability/process is tainted with high degree of uncertainty. Under these circumstances, knowing not only where and how many TLHs to establish, but also when to establish them is necessary while taking account of the uncertainty in parameter value. We develop a possibilistic multi-objective optimization model that determines

the location of TLHs and allocation of open TLHs to the demand points. The model minimizes total cost ensuring maximum demand coverage. A credibility based fuzzy chance constrained programming approach is used to account for possibilistic parameters and fuzzy multi-attribute group decision-making (FMAGDM) is used to evaluate availability of open spaces and transportation accessibility. The results of the numerical illustration shows the location, number of TLHs along with their sequence (timing) of establishment and allocation of the open facilities to PODs. Sensitivity analysis of the confidence level, and the spread of the symmetric triangular fuzzy number reveals increase in both demand coverage and total cost with increase in confidence level and spread of triangular fuzzy number.

Determining the order of establishment plays an important role in ensuring maximum utilization of the mobile storage units which are used as TLHs when they are in limited availability which is often true during the initial phase of post-disaster operation. It is worth noting that the concept of order of establishment is almost non-existent in the existing literature. From the methodological point of view, often studies have used either optimization approach or multi-criteria decision-making approach to deal with location problems. We take the benefit obtained by amalgamating an optimization approach with multi-criteria decision-making approach where the optimization model determines the optimal numbers and locations of TLHs and FMAGDM is used to determine their order of establishment. While both the mathematical models developed in chapter three and four can determine the optimal number and location of the TLHs we have developed a single objective optimization model with the objective of minimizing total unsatisfied demand to determine the initial results. FMAGDM approach employed here enables evaluation of qualitative attributes affecting the ordering decision while taking account of decision-opinion of multiple decision-makers in terms of fuzzy linguistic variables. In the numerical illustration, the decision-opinion of four decision-makers reveals availability of open spaces and transportation accessibility as the two most important attributes for determining the order of establishment of TLHs. The performance of the selected TLHs can also be observed from the results.

Based on the insights gained in the course of this dissertation, we discuss the implications our research findings have for the decision-makers for improving humanitarian operations. The application of group decision-making approach enables minimizing discrepancy caused by lack of information or information asymmetry. When the decision is made by a group more accurate information can be obtained while reducing redundancy in information and operation. The trade-off between non-commensurable objectives provide decision-makers with ample alternatives and combinations from which to choose when deciding on the available quantity of emergency relief goods as well as the number and location of the TLHs. Dynamic location sequencing allows the humanitarian relief chain network to be responsive to the changes in the factors pertinent to increasing the efficiency and effectiveness of humanitarian operations. Finally order of establishment enables efficient allocation of utilization of limited resources.