

論文の内容の要旨

論文題目 Developing a Decision Support System for Managing Conflict in Spatial Resource

Allocation: A Case Study of Post-Disaster Management in Thailand, 2004

(和訳 資源配分の空間的決定支援システムの開発

～タイ津波被害地域への救援物資配分を事例として～)

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Fair and systematic resource allocation is one of the most crucial issues in many fields, such as natural resources and environments, social welfare, engineering, and business: Among all, resource allocation in natural disaster management is particularly important as it has to be dealt with limited time and multiple types of resource donated by various aid agencies. According to the recent 30-year statistical data by the Emergency Disasters Data Base (EM-DAT), occurrences of natural disaster have kept increasing continuously. Until now, many researchers have paid attention to how to minimize losses caused by catastrophic unexpected events. Pre-disaster management systems, such as disaster warning systems and simulations of disaster and their consequences, are implemented to prevent damages or to mitigate losses by natural disasters. However, since natural disasters can take place anywhere and anytime, they may not be fully prevented. For this reason, a post-disaster management is also needed to facilitate relieving suffering of victims and bringing back their livelihoods to the sustainable condition as soon as possible.

Those post-disaster management systems which have recently been developed are mostly focused on the *information sharing* issue. Web-based Geographic Information Systems (GIS) technologies are

employed to help agencies understand the big picture of disaster and its current situation as well as share their useful data. However, though these attempts may facilitate each party's understanding of the work done by other agencies in the affected areas and reducing the time for data collection, those agencies may still need to face with the problems of lacking cooperation among parties. In addition, even though some groups of aid agencies may be willing to cooperate with each other, they still need to deal with fair resource allocation issues.

According to the interviews conducted in the areas affected by tsunami disaster, it has been often claimed that a fair resource allocation is an important issue in post-disaster management. The problems arise not only from the scarcity in resources, but also from the need for managing resources from various sources to be used efficiently. Regarding this issue, major problems are: (1) mismatching between victims' needs and aids by agencies which could lead to inefficient allocation of resources; (2) duplication of aids provided by agencies, which may cause some places overwhelming resources while others with little support; (3) unfair resource distribution when comparing between different places; and (4) lack of cooperation and inefficient use of resource as some resources need to be grouped with others for their usability. Without considering these characteristics, the resources, when allocated singly, may not provide any benefits to victims.

In summary, to tackle these problems, it is firstly needed to induce an incentive of aid agencies to cooperate with each other by making them realize the benefit of cooperation. After that, it is important to guide them as to how to create fair resource allocation schemes based upon well-defined principles of resource distribution. In this research, the author has dealt with this issue by proposing a new decision support system, termed as ViTSPRA (Visualization Tool for Spatial Resource Allocation), which can be used as a medium for sharing up-to-date information among users

and generating fair resource allocation schemes. This tool integrates the web-based mapping technology and analytic models for resource optimization.

Resource optimization models embedded in ViTSPRA are developed by incorporating socioeconomic aspects. To identify utility of an individual when receiving resources, the author has classified resources into two groups: *independent resources* and *dependent resources*. Independent resources are defined as the resource which can provide benefit for receivers on their own. Specifically speaking, the more resources provided, the more benefits passed on to victims. Examples of this type of resource are food, water, houses, and money. On the other hand, the benefits from dependent resources depend not only on how much amount has been provided, but also how they are combined or grouped with others. In other words, dependent resources can provide benefit for receivers if and only if they are formed in a group. Examples of dependent resources in the field of natural disaster are boats and engines, electric generators and light bulbs, etc.

In addition to the resource classification rules, the resource optimization model also employs two well-known resource allocation theories – utilitarian and egalitarian. The former aims at maximizing the social welfare, which is measure as the summation of individual utility in the society; while the latter aims at maximizing the welfare of the individual who is the worst in the society. Through ViTSPRA, these two approaches can be selected to generate their corresponding resource allocation schemes which show in the form of web-based mapping. This helps decision makers to visualize the problems in the same view, thereby could induce better cooperation between aid agencies. Through the geographic distribution of resources generated by the system, aid agencies can see the more benefits passed on to victims when they cooperate with each other. Besides, this system also provides the aid agencies with updated information of distribution of aids by various aid agencies.

From this, each agency can know what the others are doing in a particular location; hence the problem of duplication of aid could then be reduced.

We have examined the feasibility of a prototype system in the case study on a tsunami, the natural disaster that took place on December, 26 2004. The main objective is to compare the results generated by the system to the existing approach. The area of the case study covers three districts in Phang Nga province in Thailand, which were seriously damaged by the tsunami and faced with the problems of fair allocation of resources. Data required for the analysis are needs data by victims in the affected area and aid data by various aid agencies. The need data used for the case study were gathered from the local government office in Phang Nga, while aid data were gathered from the Disaster Tracking Recovery and Assistance Center (D-TRAC).

After the analysis, we have compared the resource allocation schemes generated by ViTSPRA and the traditional approach. Using the social welfare as the indicator, results by ViTSPRA show the more benefit could have been passed on to victims. Also, the author has investigated the potential of this system to be implemented in the real context by asking for user responses. This prototype system was proposed to Disaster Tracking Recovery and Assistance Center (D-TRAC) who is working as the coordinator for creating a venue for various aid agencies. The director of this agency has supported the possibility of implementing ViTSPRA in practice. However, some concerns have also mentioned about the quality of data which are needed to be used as input of the system. She has argued that collaborative systems, such as a data collection system and standardized need assessment system, may be required in order that this system can be effectively implemented.

In conclusion, this prototype could be viewed as a backbone structure or a starting point of

post-disaster resource optimization system for managing and utilizing shared data in the way that it could help agencies make a better decision. Some important issues of further exploration and development include: the development of data collection systems, bargaining systems for aid distribution schemes, and other algorithms for mixed resource allocation schemes.