UNIVERSITI TEKNOLOGI MARA

BI-OBJECTIVE LOCATION ALLOCATION MODEL FOR FLOOD RELIEF CENTRES: A CASE STUDY IN KUALA KUANTAN

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ABSTRACT

The frequency of natural disaster has been increasing over the years, which has resulted in the loss of life, damage to properties, and destruction of the environment. Compared to other natural disaster, floods are the most significant natural hazard in Malaysia that has affected thousands of people. Thus, a proper planning in locating relief centres especially at flood-prone areas is crucial in order to have good management in evacuating victims quickly and efficiently to avoid further worsening incidents. However, during these recent floods, several relief centres were experiencing problems when most of the flood victims were required to relocate to other relief centres after the existing shelters were affected by flood water. Furthermore, the relief centres became congested due to the receive of a large number of flood evacuees over the capacity provided. This study attempts to develop Bi-Objective location-allocation models for the allocation of flood victims during a flood event using the 'split is allowed' and 'split is not allowed' procedures. The assessment of the impact rainfall amount on the flood occurrence has been conducted. Two basic location-allocation models with two different objectives were studied: the P-median and Location Set Covering Problem (LSCP) models. Several solution procedures have been applied by considering the un-capacitated and capacitated constraints in the Bi-Objective models. The allocation of flood victims in Kuala Kuantan was studied using the model, in addition to analyses on the past and current location decisions. These models were solved using Excel solver, sensitivity analysis, Pareto analysis, and Visual Studio 2019. The finding has been compared with the actual allocation process conducted by the Department of Social Welfare (DSW). A few recommendations have been highlighted to disaster management, including the changes in flood victims' allocation pattern and enhancement of the existing allocation process to be more systematic. On the other hand, the results of this study will also contribute to avoid congestions at relief centres during an allocation process since the flood victims are alert to which relief centres they need to move to during a disaster. The assessment of rainfall amount has indicated that the actual flood event occurred in prediction period. Capacity analysis has also been conducted to solve the congestion issues at relief centres during a disaster event. Moreover, the classification of prone areas (river, inland, and coastal) was found capable to enhance the existing allocation procedure.

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TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Research Background

Natural disaster is a major adverse event resulting from natural processes of the Earth. In recent years, due to unreasonable development of ecological environment, abnormal climate events such as the Hurricane Katrina, Hurricane Rita, and critical floods have occurred more frequently. Other disasters like earthquake, tsunami, and volcanic eruption are also considered as a major hazard to millions of lives around the world. Hurricane Katrina, for instance, has caused landslides in the United States of America, which further inflicted severe losses of life and property. Among all kinds of natural disaster, flood is probably the most devastating, widespread, and frequent hazard (Sanyal and Lu., 2004; Taib et al., 2016; De et al., 2019). Flood is a global phenomenon which causes widespread devastation, economic damages, and loss of human lives (World Health Organization). Each year, flood disasters inflict tremendous losses and social disruption worldwide. Once in Cambodia, nearly 400,000 people were affected by a serious flood that had struck ten provinces (Ly and Kate, 2013).

A similar event took place in the central Thailand, which had endangered 3 million lives and caused partial or total damages on approximately 1 million homes (World Disasters Report Focus on culture and risk, 2014). According to Kittipongvises et al., (2015), Singkran (2017), and Jamrussri and Toda (2017), flood is a recurring phenomenon in several areas of Thailand, particularly in the Central Plains and the capital Bangkok. In Thailand, the likely reasons for the flood events in the country are excessive rainfall, urbanization, landuse changes, and insufficient drainage and flood protection system (Bywater, 2018). Meanwhile in Sri Lanka, the recurring floods caused by monsoon rains are typical, where such events have affected more than 7.8 million people since 2000 (Alahacoon et al., 2018). China, on the other hand, recorded extreme floods in the Yangtze River in 1998, which had caused severe flooding affecting 8 million lives (Liang et al., 2019). Indeed, China is one of the major Asia countries afflicted with frequent and severe floods. In 2018, floods in China had caused direct economic and societal losses of $15.2 billion and affected 1.42 million people, which accounted for more than 40% of all-natural disaster losses (Ministry of