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論　文　要　旨
Thesis Abstract

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主論文題名　（Title）

The Relation Between Flood Risk Management and Spatial Planning: An Evacuation Area Suitability Perspective in Malaysia

内容の要旨　（Abstract）

Malaysia is affected by major flood disasters throughout each year. Due of its geographical location, the country experiences seasonal monsoon winds that bring heavy monsoon rains to the north and east coasts. Each year, thousands of people are forced to evacuate to flood shelters (ECs) due to frequent flooding. Because of the significantly high number of flood victims and evacuees each year, the preparation of ECs across Malaysia is one of the most important aspects of the country's flood risk management (FRM). In several cases, ECs themselves have become inundated, forcing evacuees to move to other locations or remain trapped inside.

Close collaboration between multiple disciplines and agencies is required to secure safe EC sites through the integration of FRM and spatial planning and through addressing cross-cutting flood-related issues. It is, however, challenging for multiple disciplines and agencies to collaborate due to the many actors involved. Therefore, identifying the issues and challenges facing flood-related agencies is important, as these issues are addressed by various institutions at different levels through regional programmes overseen by regional entities, national programmes overseen by country governments and city- and local level activities overseen by community-level organisations.

The aim of this study is to identify the issues and challenges facing flood-related agencies when incorporating flood risk management with spatial planning to ensure EC site suitability. A mixed method of qualitative research and GIS-based analyses was used to undertake the investigation. The study used GIS-based multi-criteria analysis to investigate the spatial aspects of evacuation, and integrated GIS and qualitative analyses to identify the issues and challenges faced by flood-related agencies from the perspective of EC site suitability.

The thesis consists of six chapters. Chapter 1 provides context to the study, and presents the problem statement, the study objectives, the research questions, the significance of the research, the scope of the study and a brief outline of the research design. Chapter 2 provides a systematic review of literature related to evacuation site suitability, spatial planning, and FRM, and provides a formulation of the conceptual framework for the study. Chapter 3 examines flood risk governance using content analysis of Malaysia's three-tier spatial plan: the National Physical Plan, the State Structure Plan and the Local Plan. A qualitative thematic analysis of flood-related agencies was conducted to identify the issues and challenges they face. Chapter 4 focuses on a GIS-based multi-criteria site suitability analysis of ECs and the barriers faced by agency to achieving EC site suitability in Kuantan, the largest city on the east coast of Malaysia. Chapter 5 discusses the findings and policy implications of the results from the previous two chapters. Chapter 6 concludes the study and provides recommendations for future research.

The study found a lack of flood management-related legislation to control flood events, leading to a lack of authority and enforcement capability. In addition, at all levels of government there exists a lack declarations of collaborative risk sharing and risk management, and flood-related agencies do not cooperate with each other. An existing institution, the Malaysian Flood-related and Urban Planning Agencies, is decentralised. Furthermore, the agency responsible in selecting and managing ECs is not related to those agencies responsible for urban planning or FRM.

Kuantan has a total EC capacity for only 29,700 evacuees, even though 355,140 residents are at risk of flooding. In addition, since 66% of affected residential areas are outside a 1 km radius of ECs, the proportion of ECs available for affected residential areas and populations is insufficient. It is clear that there is no scientific basis for evacuation siting decisions, meaning that more ECs need to be built to support disaster-affected residential areas. Based on site suitability analysis, 21% of ECs in Kuantan are located at unsuitable sites, 32% are located at moderate to more suitable sites, 39% are located at very suitable sites and 8% are located at extremely suitable sites. EC sites categorised as unsuitable are situated near industrial areas, near places of low-elevation with some risk of landslide, on steep slopes and near low-elevation streams and beaches with a high risk of inundation and secondary disasters. Overall, only 47% of ECs in Kuantan are located at suitable sites. The network service area analysis revealed that 95% of the ECs located at suitable sites have good city centre road network accessibility. Only 5% have low accessibility by foot, and only 70% of people can reach these ECs within 15 minutes. This means that within 15 minutes, 246,418 people can reach the ECs on foot.

The study found a number of institutional barriers. Agencies and officers lack adequate understanding of the requirements for EC site suitability. None of the development proposals submitted to the local authority make provision for secure evacuation sites, and evacuation procedures are not included in the Kuantan Local Plan. The agency responsible for choosing and managing ECs is not associated with the agencies responsible for FRM or urban planning. Therefore, the selection of ECs is rendered without taking geo-spatial characteristics into consideration. A further problem in Kuantan is the lack of clear evacuation laws and policies at the local level. The Municipal Council of Kuantan should integrate the elements of safe EC sites into its Local Plan and its growth plan. To overcome this shortcoming, amending the current legislation, Planning Guidelines, and the requirement that planning permission applications include EC site suitability criteria will ensure the inclusion of elements of site suitability in spatial planning. The aforementioned must be supported by law, regulation, and enforcement, and can be achieved through the formulation of national policies or the amendment of Directive No. 20, Act 172 of the Town and Country Planning Act and Planning Guideline. In addition to legislation amendments, specific measures to ensure the geo-spatial siting of ECs must be included in the three tiers of spatial planning. To ensure this, executive orders must be issued, directing the state, the district government and local authorities to consider emergency planning in all future development. Spatial plans must include evacuation procedures, especially in flood-prone areas. It is also highly recommended that gazetted safe land and buildings are included as ECs in each Local Plan.

In conclusion, future research will benefit from the findings of this study with regard to detailed investigations of increasing evacuation capacity, identifying suitable EC sites and integrating FRM into spatial planning. I hope this study will provide the guidance to amendments to the National Physical Plan, the State Structure Plan and the Local Plan by including the geo-spatial elements of ECs in spatial planning and for local authorities to take seriously the matter of the suitability of EC sites to ensure and improve community resilience.