從流域觀點探討氣候行動於城鄉發展區都市計畫減洪調適規劃之研究

Study on the application of climate action in flood mitigation and adaptation planning for urban planning in urban and rural development areas from a river basin perspective

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摘要

氣候變遷對全球水環境與都市空間造成重大影響，因此將氣候變遷因應措施納入國家政策、策略和規劃當中亦為氣候行動的一環。110 年度之「氣候變遷下以成長管理觀點研擬城鄉發展區空間規劃減洪調適韌性策略之研究」，已先針對流域內單一都市計畫區進行逕流及逕流分擔措施分析，並運用成長管理的觀點，在考量水文環境與容受力的都市發展的規劃過程中，尋找適宜的開發區位和時機，並結合空間規劃之減洪調適韌性策略及透過逕流分擔措施的操作，以達到提升未來城鄉發展地區之災害調適韌性能力之目的。本研究以 110 年度研究成果為基礎繼續深化，突破傳統僅從單一都市或地區檢討減洪調適規劃模式，而從上、中、下游整體流域之跨區位思考，並扣合「極端災害下之韌性城市」政策建議八大要素之城鄉發展與設計應考量災害風險，在城鄉發展的同時考量災害風險，演算分析逕流分擔措施等減緩調適行動之成效，建議城鄉發展區調洪規劃，強化都市韌性，以因應氣候變遷之影響。

本研究選定位於鹽水溪流域的挑選「上游－虎頭埤特定區計畫」、「中游－臺南科學工業園區特定區計畫（包含科學園區及不含科學園區部分）」及「下游－臺南市安南區都市計畫（鹽水溪流域範圍）」做為操作減洪調適規劃之研究地區，並由 4 種雨量情境（豪雨：200mm/24hr、鹽水溪流域重現期 10 年降雨：275mm/24hr、大豪雨：350mm/24hr 及氣候變遷降雨情境：500mm/24hr）與都市計畫施行後之基礎地文情境、都市減洪調適規劃演算情境（透保水設施設置情境與綠色基盤設施設置情境），經城鄉發展區空間減洪水理演算模式模擬逕流現象之成果，探討其於鹽水溪流域之減洪成效。

依本研究模擬成果，影響基地透保水設施減洪成效的關鍵因素在於操作土地面積的大小。以鹽水溪流域為例，若單一都市計畫區的操作面積未達 50 公頃，則減淹效率較不顯著，須透過管制手段，規定辦理都市更新或是建築基地開發時，皆需留設一定面積

的土地設置基地透保水設施，以確保達到基地涵養或貯流滲透雨水之能力。雖然本研究針對都市計畫建成區的模擬成果顯示，當所有可供操作土地皆實施基地透保水設施，其產生的減淹面積卻不及投入操作的總面積；且產生減淹的範圍亦多位於農業區、國家公園區及公園用地等土地價值相對較低的區域。但此結果並非代表基地透保水設施沒有效益，若每一塊基地都能設置透保水設施，並在暴雨發生時，發揮滯留雨水、延緩降雨逕流排入河道的效果，依然可減輕都市地區洪患風險的產生，只是其所欲保全的對象（如建成區之住宅、商業、工業區等）並不一定會在減淹範圍內，因此若要以獎勵容積作為建築基地設置更具保水效果之雨水流出抑制措施的誘因，則必須透過城鄉發展區空間減洪水理演算模式進行模擬，評估其操作基地透保水設施產生的減洪成效，若重要保全對象位於減淹範圍內，則容積獎勵的提供才具有合理性。據研究成果顯示，綠色基盤設施減輕之淹水範圍內，除農業區外亦包含聚落與工業區等重要保全對象，於都市減洪調適規劃上具有實質成效。設置於農業區綠色基盤設施之減洪成效高於公園用地與綠地用地、設置區位鄰近淹水潛勢範圍綠色基盤設施具有較佳減淹成效，故建議未來進行綠色基盤設施空間規劃策略時，應以農業區在地滯洪方式、鄰近淹水潛勢範圍區位做為優先考量，以充分發揮綠色基盤設施減洪調適之功能與成效。

在都市規劃流程方面，建議能將本研究所提出之減洪調適評估操作模式納入其中。在「資料蒐集調查與分析」部分，應補充建置與本研究相關之一手及二手資料於「上位暨相關計畫與現行計畫」、「自然生態環境」及「都市防災」等部分，以掌握都市計畫地區的淹水災害情形；在「發展預測分析」部分，應考慮將淹水模擬納入發展預測當中，並以本研究建置之城鄉發展區空間減洪水理演算模式，模擬都市計畫區在不同降雨情境下，操作都市減洪調適措施所產生的減洪成效及減淹範圍。透過淹水預測及分析，作為擬定該地區「整體發展構想」之考量，並以此訂定都市計畫未來發展之目標及方向。而在「研擬課題與對策」及「檢討後計畫內容」部分，則應針對實務面提出都市減洪調適規劃所會面臨之課題，並研擬相關對策加以因應及改善，例如：在土地使用分區管制、公共設施用地計畫及都市防災計畫等方面進行檢討，提出合理且適當的規劃，以因應氣候變遷對都市地區造成的影響。

關鍵詞：氣候行動、都市計畫、減洪調適規劃

Abstract

Climate change has a significant impact on the global water environment and urban space. Incorporating climate change response measures into national policies, strategies and plans has become a part of climate action. In the project in 2021, we selected single urban planning area, from the viewpoint of growth management, combined with hydraulic analysis, we designed resilient strategies for flood mitigation and adaptation while taking note of urban development plans and of flood mitigation. This study is based on the results of the project in 2021, ”The study on resilient strategies of flood mitigation and adaptation for urban and rural development areas under climate change”. Breaking through the tradition, we only review the flood mitigation and adaptation planning model from a single city or region, but from the

cross-regional thinking of the entire river basin in the upstream, midstream and downstream. In the policy recommendations of "Resilient Cities under Extreme Disasters", urban and rural development and design should consider disaster risks. Consider disaster risks while developing urban and rural areas, calculate and analyze the effectiveness of mitigation and adaptation actions such as runoff allocation measures, and recommend flood mitigation planning in urban and rural development areas to strengthen urban resilience to cope with the impact of climate change.

The upstream, “Hutoupi Special District Plan”, the midstream, “Tainan Science Park Special District Plan”, and the downstream, “Annan District Urban Plan “, in the Yen-Shui River basin is selected as the study areas for operational flood mitigation and adaptation measures planning. From the simulation results and discussions of the basic geography situation after the implementation of the urban plan and the geography situation after the flood mitigation and adaption planning (water conservation measures and green infrastructure measures) under the 4 quantitative rainfall scenarios (extremely heavy rain: 200mm/24hr, 10-year return period rainfall in Yen-Shui river basin: 275mm/24hr, torrential rain: 350mm/24hr, and rainfall under climate change effect: 500mm/24hr).

The key factor affecting the flood mitigation effectiveness of the water conservation measures is the size of the operating area. In this study, if the operating area of a single urban planning division area is less than 50 hectares, the flood mitigation effectiveness will be less significant. Although the flood mitigation effectiveness is not significant, we can still use regulatory means to stipulate that a certain area needs to be reserved when urban renewal or building lot development is carried out, and water conservation measures are implemented to ensure that the base can conserve or store runoff and infiltrate rainwater ability. In this study, green infrastructure measures are planned and implement in the urban planning division area of the Yen-Shui River basin. Within the range of flood mitigation areas, in addition to agricultural areas, important objects that need to be protected, such as settlements and industrial areas. It has achieved substantial results in urban flood mitigation and adaption planning. The flood mitigation effectiveness of planning and implement green infrastructure measures in agricultural areas is higher than that of land used for park and green. The green infrastructure measures implemented near or in the vicinity or within the flood potential areas have better flood mitigation effectiveness. Therefore, it is recommended that when carrying out the spatial planning strategy of green infrastructure measures in the future, priority should be given to local flood detention in agricultural areas and setting them in the vicinity or within the flood potential areas, so as to fully exert the functions and effectiveness of flood mitigation and adaption of green infrastructure measures.

It is recommended that the flood mitigation and adaptation planning operations proposed in this study can be incorporated into urban planning process. In the "Data Collection, Investigation and Analysis" section, direct and indirect data related to this study should be added to the "Master and Related Plans and Current Plans", "Natural Ecological

Environment" and "Urban Disaster Prevention" to grasp the status of flood disasters in urban planning division areas. In the "Development Prediction Analysis" section, it should be considered to incorporate flood simulation into the development prediction, and use the urban and rural development area spatial flood mitigation simulation model established in this study to simulate the flood mitigation effectiveness and scope after the operation of flood adaption measures implement in urban planning areas under different rainfall scenarios. Through flood prediction and analysis, it is used as a consideration in formulating the "Overall Development Concept" of the area, and based on this, the goals and directions of the future development of the urban plan division are determined. In the sections of " Propose Issues and Strategies" and "Plan Contents after Review", the issues that urban flood mitigation and adaptation planning will face should be raised from the practical point of view, and relevant strategies should be formulated to cope with and improve, such as: land use zoning control, review the public facility land use plan and urban disaster prevention plan, and propose reasonable and appropriate plans to respond to the impact of climate change on urban areas.

Keywords：climate action, urban planning, flood mitigation and adaptation planning.