國立臺灣大學園藝暨景觀學系

綠地生態系統服務研究室 Greenland Ecosystem Services Lab, GES LAB

本研究室為綠地生態系統服務研究室（Greenland Ecosystem Services Lab, GES LAB），研究室始於2012年8月，主要研究綠屋頂、立面綠化、公園綠地等綠色基盤在都市環境中的生態系統服務，包括微氣候調節效益、改善空氣品質、休閒遊憩效益等，期在現今氣候變遷、都市化、環境品質下降的情況下，對永續發展提供助益。

生態系統服務(ecosystem services, ES)係指人類直接或間接從生態系統中受益，其涵蓋許多生態、生物物理、與社會價值的多面向概念，由自然資產透過結構、過程與功能，提供產品與服務予人類，包括食物供給、氣候調節、空氣淨化、休閒遊憩、美學體驗等，進而增進人類福祉。 都市是人類聚居的主要空間，都市化是地表上重大的地貌改變，但儘管如此，都市仍然依賴生態系統提供的許多服務，然而都市擴張與都市發展規模、都市生活型態卻造成都市內部與都市外部自然環境的破壞，引發氣候變遷、生態系統與環境品質下降的危機。關注與提升生態系統服務將能增進環境品質、增進人類福祉、邁向永續發展。

研究室主持人

林寶秀 教授
生態系統服務評估與製圖
景觀規劃設計
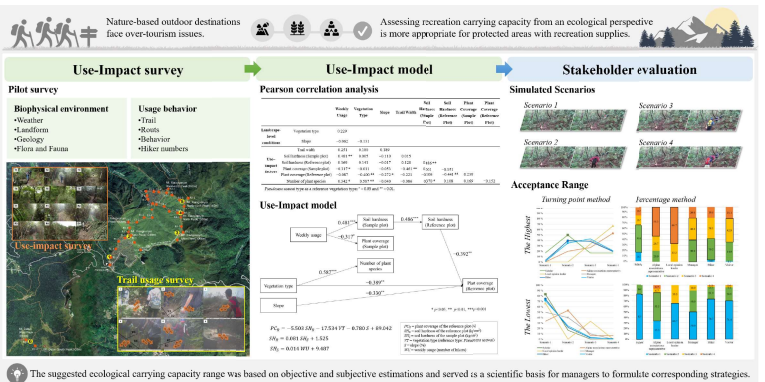景觀生態
綠地系統與綠色基盤
綠屋頂設計與效益評估
遊憩供給與需求

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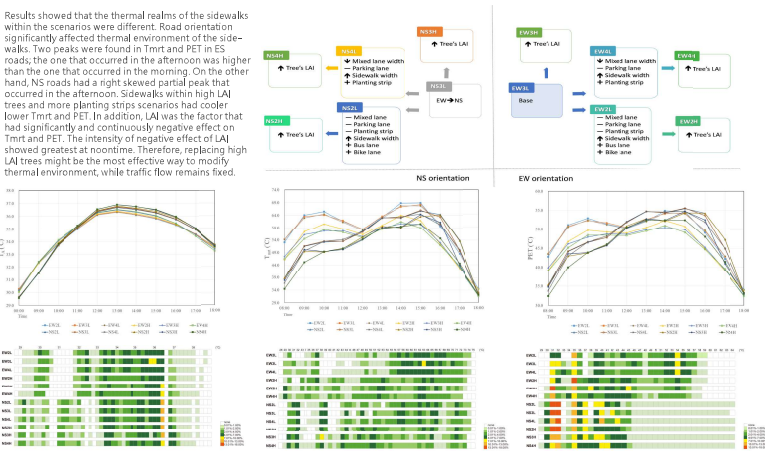**范家鳳** 碩士班研究生112級
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研究成果

Ecological Carrying Capacity Estimation of the Trails in a Protected Area: Integrating a Path Analysis Model and the Stakeholders' Evaluation

This study integrated a path analysis model and stakeholder assessment to estimate the ecological carrying capacity of trails in a protected area. This study surveyed the biophysical environment along the trails and conducted a path analysis to establish the use–impact model for the trails in the study area. Based on the use–impact model, this study developed four-level usage scenarios and collected the stakeholders' acceptance evaluation to determine the ecological carrying capacity range. The results showed that the weekly usage of the trails directly affected the soil hardness and plant coverage of the trail. The trail's soil hardness directly affected the surrounding soil hardness, decreasing its plant coverage, while the vegetation type and slope also affected its plant cover. The stakeholders of the Mt. Xiaoguanyin Area reached a consensus on the ecological carrying capacity range, which was 288 to 404 total weekly hikers.

The suggested ecological carrying capacity range was based on objective and subjective estimations and served as a scientific basis for managers to formulate corresponding strategies.

Study of thermal environment of sidewalks within varied urban road structures

Road is one of the major components that make up urban outdoor space. Due to the popularity of personal vehicles and urban sprawling, vehicle-oriented transportation has been dominating the road design for decades and worsening urban outdoor thermal environment. The purpose of this study was to assess the thermal environment of the potential humanity-oriented designed roads which expand sidewalks for better walking experience. To increase human thermal comfort, road orientation, the number of planting strips, and leaf area index (LAI) of trees were considered to develop alternative scenarios. Validated with field measurements by this study, ENVI-met was used to simulate the thermal environment of the sidewalks within the scenarios.

Results showed that the thermal realms of the sidewalks within the scenarios were different. Road orientation significantly affected thermal environment of the sidewalks. Two peaks were found in Tmrt and PET in ES roads; the one that occurred in the afternoon was higher than the one that occurred in the morning. On the other hand, NS roads had a right skewed partial peak that occurred in the afternoon. Sidewalks within high LAI trees and more planting strips scenarios had cooler lower Tmrt and PET. In addition, LAI was the factor that had significantly and continuously negative effect on Tmrt and PET. The intensity of negative effect of LAI showed greatest at noontime. Therefore, replacing high LAI trees might be the most effective way to modify thermal environment, while traffic flow remains fixed.

A Practicing Model to Achieve Satoyama Lifestyle: Integrating the Satoyama Initiative, Satoyama Capitalism, and Placemaking

In this study, we conducted a comprehensive literature review, field study, and in-depth interview to gather successful experiences to establish a practicing model to achieve satoyama lifestyle for reference.

The effect of street greenery and permeable pavements on pedestrian thermal comfort

一、研究地點
Sec. 3, Xinsheng S. Road, one of the base roads we selected in Taipei City.

二、ENVI-met 軟體驗證

三、模擬方案與結果
The mean PET(℃) at noon(10:00–12:00) of the sidewalks within the scenarios.
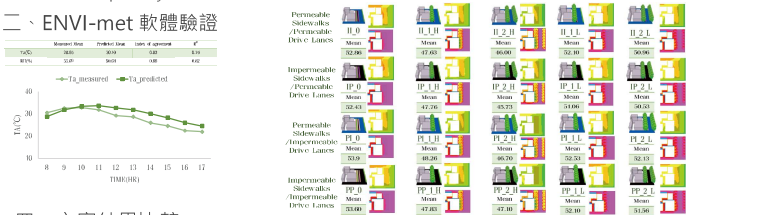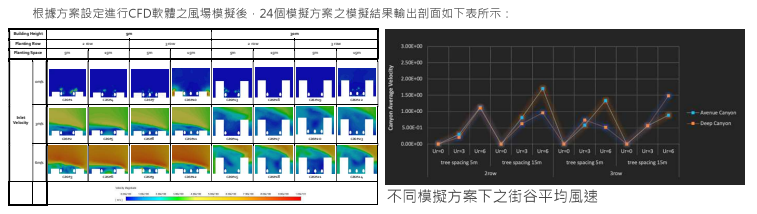

四、方案結果比較
- The result implied that LAI and number of planting strips have strong influence on PET.
- The order of cooling effect is the scenarios with 2 planting strips and high LAI, the scenarios with 1 planting strip and high LAI, the scenarios with 2 planting strips and low LAI, the scenarios with 1 planting strip and low LAI.
- For the same number of planting strips, and the same tree LAI, impermeable sidewalks and permeable drive lanes resulted in the largest cooling effect in general.
- For the same number of planting strips, and the same tree LAI, impermeable sidewalks and impermeable drive lanes resulted in a larger cooling effect than permeable sidewalks and permeable drive lanes.

The Effects of Various Types of Street Canyons and Trees on the Urban Wind Environment

隨著全球都市化、熱島效應增強，都市熱環境成為一重要課題，都市風場亦成為廣泛討論的議題之一。人類頻繁活動之街道空間中，對流傳熱率受到都市冠層（urban canopy layer, UCL）內風速影響，密集的都市建築會對街谷內通風狀況產生負面影響，進而影響街谷的散熱效果。

本研究欲了解在不同基礎風速與街道高寬比下，不同植栽帶排數與植栽間距對街廓風場的影響，並推展街廓風場之預測式。以計算流體力學（Computational Fluid Dynamics, CFD）數值模擬方法針對不同方案組合進行街廓風場模擬，由研究結果可知街道高寬比、植栽配置確實會對街谷風場產生影響，由於已建成都市中建築物型態已成定局，因此期望研究成果能有助於考量不同植栽配置對於不同型態街廓之適用性，達到改善都市風場之效用。

根據方案設定進行CFD軟體之風場模擬後，24個模擬方案之模擬結果輸出剖面如下表所示：

不同模擬方案下之街谷平均風速

A method to detect the spatial matching relationship of supply and demand of recreation ecosystem services (RES) as policy and decision-making support in a protected area

Recreation ecosystem services (RES) link closely to human well-being and benefit mutually to biodiversity conservation. However, how to assess and detect the spatial matching of RES remains a challenge. Based on the ES cascade model and referring to previous studies, this study defined RES Supply Potential, RES Demand, RES Flow, and RES Match/Mismatch to convey these terms' intrinsic appropriately; and Recreation Accessibility was treated as a RES supply term. The proposed method consisted of three assessment parts and an overlay analysis. RES Supply Potential and Recreation Accessibility were assessed by indicator assessment method. RES Demand and RES Flow were assessed from the beneficiaries' perspective by administering web-based questionnaires. The matching relationship between RES Demand and RES Flow was further analyzed to detect RES Match/Mismatch. An overlay analysis was then conducted to examine the spatial relationship between the RES Match/Mismatch and the resource supply status to provide specific management information. Through a questionnaire with reliability and content validity and 634 samples (95% confidence level, 4% confidence interval), the detected RES Match/Mismatch of this study was trustable. This study revealed four RES Match/Mismatch levels in Yangmingshan National Park (YNP). Only 5.51% of YNP belonged to M (RES Demand ≈ RES Flow). MM–1 (RES demand <RES flow) accounted for 7.12% and had high Recreation Accessibility, which was the area that the managers should first launch dispersed actions to avoid or minimize over-visited impacts. The proposed method could not only detect RES Match/Mismatch rationally and directly but also obtained multiple spatial datasets to support decision-making.
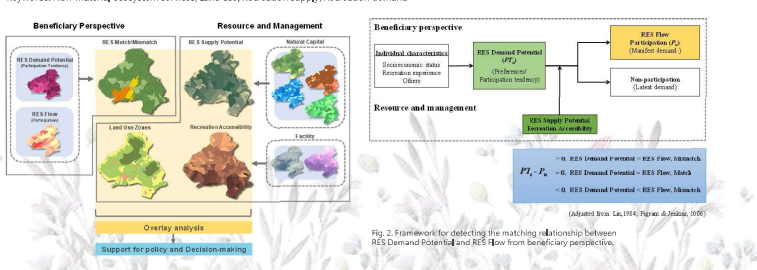Keywords: Non-material ecosystem services; Land use; Recreation supply; Recreation demand

Fig. 1. The method and procedure for assessing and detecting the spatial matching relationship of supply and demand of RES as policy and decision-making support.

Fig. 2. Framework for detecting the matching relationship between RES Demand Potential and RES Flow from beneficiary perspective.
(Adapted from Lea,1984; Pigram & Jenkins, 2006)

$PT_d - P_s = \begin{cases} > 0, & \text{RES Demand Potential} > \text{RES Flow, Mismatch} \\ = 0, & \text{RES Demand Potential} = \text{RES Flow, Match} \\ < 0, & \text{RES Demand Potential} < \text{RES Flow, Mismatch} \end{cases}$