國立臺北大學都市計劃研究所 112 學年度第二學期

水土不可分
流域治理與河川環境規劃設計
Watershed & Riverine Ecosystem Governance

授課老師: 廖桂賢 / 都市計劃研究所教授
上課時間: 原則上每週三下午 3:30-6:00，校外教學視情況調整
教室：公共事務學院 630
教學助理：賴慕易 / 都市計劃研究所碩士班二年級（muhyeh88911@gmail.com）

課程簡介

無論是大河小溪，在人類社會、經濟、文化發展上扮演重要角色；然而，社會大眾普遍不了解河川生態健康對社會經濟發展的重要性，包括河川生態系服務在氣候變遷減緩與調適上的潛力。河川不是被視為應盡可能利用之水資源，就是應以工程整治之禍源。此外，河川相關事務（水患治理、水資源利用、水污染處理等）在台灣被過度簡化為「水利工程」課題，且事權分散，亦尚未出現河川生態保育與河川復育之積極政策。然而，水土無法截然二分，河川相關事務均需要宏觀整合且著眼流域尺度之治理方式，且任何尺度的空間都規劃必須考量現有之河川溪流。在生物多樣性嚴重流失、氣候變遷事態愈來愈緊急的世界中，解決環境問題需要跨領域知識整合與跨部門分工合作，河川之治理亦然，需要空間規劃專業者積極投入。本課程透過講座與課堂討論，輔以校外走讀，讓學生認識流域與河川治理相關課題並學習新觀念，以期未來在空間規劃中納入相關考量，以協助提升台灣流域與河川之健康。

教學目標 學生修習本課程後將預期能夠：

1. 認識水文與河川生態相關基本知識
2. 體認河川健康對人類社會、經濟、文化發展之重要性
3. 認識河川治理相關事務，包括水患治理、生態保育復育等
4. 理解流域與河川治理之相關新概念與作法

指定讀物

- 廖桂賢，2017。第三部〈與水和平共存不是夢想〉，第 90~133 頁，《好城市：綠設計，慢哲學，啟動未來城市整建計畫》。台北：野人出版社
- 廖桂賢，2023。第六部：從空間規劃專業拆解社子島開發問題。廖桂賢主編，《城中一座島：築堤逐水、徵土爭權，社子島開發與臺灣的都市計畫》春山出版社

授課時間表與參考讀物

紅色日期/課程日期非常態課程時間或地點　藍字/校外講者之講座　綠字/校外走讀

2/21 講座 **課程介紹 + 基本概念與相關名詞認識**

讀物
- Free-flowing rivers are the freshwater equivalent of wilderness areas. WWF
- Ganey S, Surrier L. 2022. 8 benefits of healthy, free-flowing rivers. Pew.

2/28 和平紀念日

2/29 講座 **河川治理新思維**

19:00-21:00 台灣共用資源治理學會主辦之線上演講，請先報名

讀物
- Why rivers shouldn't look like this

3/06 講座 **河川水文與河川生態基礎知識**

陳嘉修 / 野聲環境生態公司經理

讀物
- The water cycle | Ecology. Khan Academy
- Our Planet | Fresh Water. Netflix
- 游保衫，2004。水文循環與洪水。科學發展 374 期，第 6-13 頁

3/13 走讀 **台灣水患治理現況：拜訪水利署水利防災組並參訪大台北防洪水工模型**

14:00-17:00 地點：水利署新店辦公室（新北市新店區安和路三段 76 號）

讀物
- Sayers P, Yuanyuan L, Galloway G, Penning-Rowsell E, Shen F, Wen K, Chen Y, Le Quesne T. 2013. Executive Summary (p3-9) in Flood Risk Management: A Strategic Approach. Paris, UNESCO

3/20 講座 **河川之生物化學面向及其治理 + 生態檢核**

黃于玻 / 觀察家生態顧問公司總經理、生態專業技術服務同業商業公會理事長

3/27 講座 **河川生態系服務 + 河川復育**

讀物
- Petsch DK, de Mello Cionet V, Thomaz SM, dos Santos NCL. 2022. Ecosystem services provided by river-floodplain ecosystems. Hydrobiologia. https://doi.org/10.1007/s10750-022-04916-7
- Wohl E, Lane S, Wilcox AC. 2015. The science and practice of river restoration. Water Resources Research 51: 5974-5997

4/03 北大放假

4/10 課程移至 4/13

4/13 走讀 **自然溪流棲地評估：坪林金瓜寮魚蕨步道**

13:30-16:30 劉廷彥 / 觀察家生態顧問公司生態工程部技術經理

讀物
- 農業部林業及自然保育署，2023。林業保育署公共工程生態友善機制手冊。附件三：野溪治理工程生態追蹤評估指標
- Rapid biological assessment protocols: An introduction

4/17 講座 **營力、棲地與台灣河溪常見生物**

方韻如 / 人禾環境倫理發展基金會特約研究員

讀物
- 島讀河溪

4/24 講座 **水患治理的過去與現在**

王順加 / 以樂工程顧問公司總經理

讀物
- 廖桂賢，2018。極端氣候下的水患治理：先丟棄「快速流下主義」！鳴人堂
- 廖桂賢，2014。水患不能只是工程的問題 - 關於淹水，我們找對方向了嗎？鳴人堂

5/01 講座 **永續雨水逕流治理與藍綠基盤**

讀物
- Liao K-H, Deng SN, Tan PY. 2017. Blue-green infrastructure: New frontier for sustainable urban stormwater management. Chapter 10 (p.203-226) in Tan PY, Jim CY, editors. Greening Cities: Forms and Functions. Springer Nature Singapore Pte Ltd, Singapore.

5/05 講座 **韌性理論應用於水患治理：承洪韌性**

14:00-16:00

齊柏林基金會主辦之《韌島》展覽主題演講

地點：淡水齊講堂 (新北市淡水區中正路 298 號 2 樓)

讀物
- 廖桂賢，2020。承洪韌性是什麼？跟防洪有什麼關係？2020 新北市政府水利局年報，第 10-15 頁
- 廖桂賢，2021。〈不怕水淹，更要與洪水共生！打造具有「承洪韌性」的城市培養指南〉台北村落之聲
- 廖桂賢，2021。打造一個「淹水也讓人喜歡的韌性聚落：掌潭村的耐淹規劃。眼底城事
- 廖桂賢，2017。韌性城市不是「不淹水」而是「不怕水淹」。鳴人堂

5/08 走讀 **都市水環境改善實例：指南溪與永春陂**

14:00-18:00

劉柏宏 / 經典工程顧問公司主持人、OURs 專業者都市改革組織理事長

讀物
- 廖桂賢，2018。台灣都市河川的前瞻想像。水資源管理會刊第 20 卷第 2 期，第 40-49 頁
- Everard M, Moggridge HL. 2012. Rediscovering the value of urban rivers. Urban Ecosystems 15: 293-314

5/15 講座 **流域與河川治理之自然解方**

讀物
- A new type of river management is coming!
- The Wildlife Trust: How nature can help prevent flooding
- 廖桂賢、鄒明軒，2023。台灣推動水患治理自然解方的挑戰與建議。水資源管理會刊第 25 卷第一期

5/22 課程移至 5/05

5/29 講座 **水環境改善之空間規劃 + 河川療癒**

劉長青 / 台灣河溪網研究員、眾森自然工作室共同創辦人

讀物
- 陳彥仲，2016。水資源管理與都市及區域空間規畫。科學發展 520 期: 22-27

6/05 討論 **期末綜合討論**

課堂規定

1. 盡可能出席每一堂課，且務必提前或準時到堂，以尊重授課老師與其他同學。比授課老師晚到五分鐘以上，請勿進入教室，除非事先提供正當理由。若上課當天遇不可抗力之理由，仍可進教室，但課後請向授課老師說明遲到原因。
2. 請於每週上課前先行閱讀完畢上表所列之參考讀物。
3. 課堂參與對於學習至為重要，請積極回答老師的提問，並主動提問。任何關於講座之問題，請於上課時提出；除非有特殊理由，不接受下課後才提出之問題。
4. 勿在課堂上趴下來睡覺。如果真的很睏，歡迎到教室外呼吸新鮮空氣後再回來。
5. 一心多用極可能一事無成。請參考 "Students think they can multitask. Here's proof they can't" 一文。因此，除非教學活動需要，上課原則上禁止使用手機，且勿將手機放桌上，
6. 請以紙筆做筆記，不要用筆電。打字的聲音會干擾授課老師與其他同學，且用筆電做筆記的學習效果遠不如用紙筆好，請參考 "A learning secrete: Don't take notes with a laptop"一文。若因特殊原因必須使用筆電做筆記，可與授課老師討論。
7. 期末作業遲交十分鐘以上以零分計算。有不可抗力之理由，事前必須與授課老師討論。

評量方式

30% 課堂參與：本課程每堂課（包括校外走讀）均有討論環節，同學應積極發言參與討論。

70% 期末報告：請選擇一個河川流域做「流域整體規劃」，都市與鄉村地區皆可，河川規模與流域範圍不宜太大，以免難以掌握。此流域整體規劃並無樣板，請根據所學自由發揮，盡可能創新，結合國際前瞻思維，但請滿足以下要求：

- 所設定之計畫目標應包含（但不限於）河川健康之保育或復育
- 盤點流域/河川面臨之課題並且呈現基本圖資
- 無需繳交文字報告，請以清楚易懂之文圖並茂文件（類懶人包模式）呈現規劃成果
- 報告請勿超過二十五頁，期末無需口頭報告，各組相互評論，因此請確保報告清楚易懂。

進階參考讀物

綜合

- Global Water Partnership. 2021. Integrating data to improve the protection and restoration of freshwater ecosystems.
- The Federal Interagency Stream Restoration Working Group. 1998. Stream Corridor Restoration: Principles, Processes, and Practices.

河川水文與生態基礎知識

The river continuum concept

- Vannote RL, Minshall GW, Cummins KW, Sedell JR, Cushing CE. 1980. Canadian Journal of Fisheries and Aquatic Science 37: 130-137. https://doi.org/10.1139/f80-017
- Doretto A, Piano E, Larson CE. 2020. The River Continuum Concept: lessons from the past and perspectives for the future. Canadian Journal of Fisheries and Aquatic Science 77(11): 1853-1864. https://doi.org/10.1139/cjfas-2020-0039
- 方偉達、周睿鈺。2005。河川續動與洪泛脈動：探討河域生態學之演進觀念。國立台灣大學建築與城鄉研究學報，第十四期，第 69-80 頁。

The flood pulse concept

- Junk W, Bayley PB, Sparks RE. 1989. The flood pulse concept in river-floodplain systems. Pages 110-127 in D.P. Dodge, ed. Proceedings of the International Large River Symposium (LARS). Canadian Special Publication of Fisheries and Aquatic Sciences 106.
- Tockner K. Malard F, Ward JV. 2000. An extension of the flood pulse concept. Hydrological processes 14(16-17): 2861-2883.

Natural flow regime & Ecohydrology

- Poff NL, Allan JD, Bain MB, Karr JR, Prestegaard KL, Richter BD, Sparks RE, Stromberg JC. 1997. The natural flow regime: A paradigm for river conservation and restoration. BioScience 47(11): 769-784.
- Naiman RJ, Latterell JJ, Pettit NE, Olden JD. 2008. Flow variability and the biophysical vitality of river systems. Geoscience 340: 629-643.

Nutrient spiraling

- Newbold JD, O'Neill RV, Elwood JW, Winkle WV. 1982. Nutrient spiraling in streams: implications for nutrient limitation and invertebrate activity. The American Naturalist 120(5): 628-652. https://doi.org/10.1086/284017
- Ensign SH, Doyle MW. 2006. Nutrient spiraling in streams and river networks. Journal of Geophysical Research: Biogeosciences 111(G04009): 1-13. https://doi.org/10.1029/2005JG000114

Floodplains & floodplain rivers

- Tockner K, Bunn SE, Gordon C, Naiman R, Quinn G, Stanford JA. 2008. Flood plains: critically threatened ecosystems. In Polunin N, ed. Aquatic Ecosystems. Cambridge University Press.
- Bayley PB. 1995. Understanding large river-floodplain ecosystems. BioScience 45(3): 153-158.

The serial discontinuity concept

- Ward JV, Stanford JA. 1983. The serial discontinuity concept of lotic ecosystems
- Ward JV, Stanford JA. 1995. The serial discontinuity concept: Extending the model to floodplain rivers. Regulated Rivers: Research and Management 10(2-4): 159-168.
- Stanford JA, Ward JV. 2001. Revisiting the serial discontinuity concept. Regulated Rivers: Research and Management 17(4-5): 303-310.

Biodiversity

- Ward JV, Tockner K. 2001. Biodiversity: towards a unifying theme for river ecology. Freshwater Biology 46: 807-819.
- Ward JV, Tockner K, Arscott DB, Claret C. 2002. Riverine landscape diversity. Freshwater Biodiversity 47: 517-539.

Riparian zones

- Naiman RJ, Decamps H. 1997. The ecology of interfaces: Riparian zones. Annual Review of Ecology & Systematics 28: 621-658.
- Tabacchi E, Lambs L, Guilloy H, Planty-Tabacchi A-M, Muller E, Decamps H. 2000. Impacts of riparian vegetation on hydrological processes. Hydrological processes 14: 2959-2976.
- 台灣研究：Liao Y-C, Lin A-C, Tsai H-N, Yen Y-T, Tzeng C-S, Yang M-M, Lin H-J. 2022. The significance of riparian communities in the energy flow of subtropical stream ecosystems. Aquatic Sciences 84:20.

Fluvial geomorphology

- 楊佳寧、郭鎮維、游牧笛、沈淑敏，2022。臺灣河川流域區、地形分段與類群建構與分析。中華水土保持學報，53(1): 13-24
- Land SN, Richards KS. 1997. Linking river channel form and process: time, space and causality revisited. Earth Surface Processes and Landforms 22: 249-260.
- Thoms MC. 2006. Variability in riverine ecosystems. River Research and Applications 22: 115-121.

- Fryirs K. 2017. River sensitivity: a lost foundation concept in fluvial geomorphology. Earth Surface Processes and Landforms 42:55-70.

河川生態系服務

- Lynch AJ et al. 2023. People need freshwater biodiversity. WIREs Water e1633.
- Yeakley JA, Ervin D, Chang H, Granek EF, Dujon V, Shandas V, Brown D. 2016. Ecosystem services of streams and rivers. In Gilver DJ, Greenwood MT, Thoms MC, Wood PJ, eds. River Science: Research and Management for the 21st Century. John Wiley & Sons, Ltd.

溪流棲地評估

- Barbour MT, Gerritsen J, Snyder BD, Stribling JB. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. Chapter 5 Habitat assessment and physicochemical parameters. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

河川連結性與其管理

- Ganey S, Surrier L. 2022. 8 benefits of healthy, free-flowing rivers. Pew.
- Opperman J. 2023. Connections matter: the importance of freshwater connectivity. Connections matter part 2: Shelter from the storm. Connections matter part 3: Break up the concrete. Forbes
- Poff NL. 2019. A river that flows free connects up in 4D. Nature 569: 201-202
- Gill G. et al. 2019. Mapping the world's free flowing rivers. Nature 569: 215-221.
- Thieme et al. 2023. Measures to safeguard and restore river connectivity. Environmental Reviews 11: 1-21.
- Thieme et al. 2021. Navigating trade-offs between dams and river conservation. Global Sustainability 4: e17

河川管理思維與政策

- 孫建平，2016。水與生活：水資源管理與生態環境。科學發展 520 期: 16-21
- Wantzen KM, Ballouche A, Longuet I, Bao I, Bocoum H, Cisse L, Chauhan M, Girard P, Gopal B, Kane A, Marchese MR, Nautiyal P, Teixeira P, Zalewski M. 2016. River culture: an eco-social approach to itigate the biological and cultural diversity crisis in riverscapes. Ecohydrology & Hydrobiology 16: 7-18
- Birnie_Gauvin K et al. 2023. The RACE for freshwater biodiversity: essential actions to create the social context for meaningful conservation. Conservation Science and Practice 5: e12911
- Parsons M, Thoms MC, Flotemersch JE. 2017. Eight river principles for navigating the science-policy interface. Marine and Freshwater Research 68: 401-410
- Cooke SJ et al. 2023. Is it a new day for freshwater biodiversity? Reflections on outcomes of the Kunming-Montreal Global Biodiversity Framework. PLOS Sustainability and Transformation 2(5): e0000065
- Cooke SJ et al. 2022. Freshwater perspective on the United Nations decade for ecosystem restoration. Conservation Science and Practice 4: e12787

河川復育

- Palmer M, Ruhi A. 2019. Linkages between flow regime, biota, and ecosystem processes: implications for river restoration. Science 365, eaaw2087
- Palmer MA, Hondula KL, Koch BJ. 2014. Ecological restoration of streams and rivers: shifting strategies and shifting goals. Annual Review of Ecology, Evolution, and Systematics 45: 247-69

- Johnson MF, et al. 2019. Biomic river restoration: A new focus for river management. River Research and Applications 36: 3–12
- Palmer MA, et al. 2005. Standards for ecologically successful river restoration. Journal of Applied Ecology 42(2): 208-217
- Kondolf GM. 1995. Five elements for effective evaluation of stream restoration. Restoration Ecology 3(2): 133-136
- Smith B, Clifford NJ, Mant J. 2014. The changing nature of river restoration. WIRs Water 1(3): 249-261

都市河川復育

- Basak SM, Hossain MS, Tusznio J, Grodzinska-Jurczak. 2021. Social benefits of river restoration from ecosystem services perspective: A systematic review. Environmental Science & Policy 124: 90-100
- Guimaraes LF, Teixeira FC, Pereira JN, Becker BR, Oliveira AKB, Lima AF, Verol AP, Miguez MG. 2021. The challenges of urban river restoration and the proposition of a framework towards river restoration goals. Journal of Cleaner Production 316: 128330

水患治理

- Sayers P, Yuanyuan L, Galloway G, Penning-Rowsell E, Shen F, Wen K, Chen Y, Le Quesne T. 2013. Flood Risk Management: A Strategic Approach. Paris, UNESCO
- Hartmann T, Slavikova L, Wilkinson ME. 2022. Introduction to spatial flood risk management: implementing catchment-based retention and resilience on private land. Chapter 1 (p1-11) in Hartmann T, Slavikova L, Wilkinson ME, editors. Spatial Flood Risk Management: Implementing Catchment-based Retention and Resilience on Private Land. Edward Elgar Publishing, Cheltenham, UK.

承洪韌性

- Kuang D, Liao K-H. 2022. How does flood resistance affect learning from flood experiences? A study of two communities in Central China. Climatic Change 173: 6. https://doi.org/10.1007/s10584-022-03401-3
- Kuang D, Liao K-H. 2020. Learning from floods: linking flood experience and flood resilience. Journal of Environmental Management 271: 111025. https://doi.org/10.1016/j.jenvman.2020.111025
- Liao K-H, Le AT, Nguyen KV. 2016. Urban design principles for flood resilience: Learning from the ecological wisdom of living with floods in the Vietnamese Mekong Delta. Landscape and Urban Planning 155: 69-78. https://doi.org/10.1016/j.landurbplan.2016.01.014
- Liao K-H. 2014. From flood control to flood adaptation: A case study on the Lower Green River Valley and the City of Kent in King County, Washington. Natural Hazards 71: 723-750. https://link.springer.com/article/10.1007/s11069-013-0923-4
- Liao K-H. 2014. Towards resilient, floodable cities: Floodability as an alternative flood safety standard to promote river health. DSD International Conference 2014. Hong Kong. http://www.dsd.gov.hk/rdforum/2014/abstract/Paper%20(A1-3).pdf
- Liao K-H. 2012. A theory on urban resilience to floods—a basis for alternative planning practices. Ecology and Society 17(4): 48. https://www.ecologyandsociety.org/vol17/iss4/art48/

永續雨水逕流治理/藍綠基盤

- Qiao X-J, Liao K-H, Randrup TB. 2020. Sustainable stormwater management: A qualitative case study of the Sponge Cities initiative in China. Sustainable Cities and Society 53: 101963. https://doi.org/10.1016/j.scs.2019.101963
- Liao K-H. 2019. The socio-ecological practice of building blue-green infrastructure in high-density cities: what does the ABC Waters Program in Singapore tell us? *Socio-Ecological Practice Research* 1(1): 67-81. https://doi.org/10.1007/s42532-019-00009-3

水患治理（工程手段與防洪思維）之問題

- Liao K-H, Chiang Y-S, Chan JKH. 2023. The levee dilemma game: A game experiment on flood management decision-making. International Journal of Disaster Risk Reduction 90: 103662. https://doi.org/10.1016/j.ijdrr.2023.103662
- Chan JKH, Liao K-H. 2022. The normative dimensions of flood risk management: Two types of flood harm. Journal of Flood Risk Management 15(2): e12978. https://doi.org/10.1111/jfr3.12798
- Liao K-H. 2022. The social downside of flood control: The case of a marginalized community in Taipei. Chapter 10 (p.241-246) in Padawangi R, Rabé P, Perkasa A, editors. River Cities in Asia: Waterways in Urban Development and History. Amsterdam University Press, Amsterdam.
- Liao K-H, Lee TY. 2022. A classic case of the struggle to control a river: Is it wise to sacrifice the social and ecological functions of the river for flood safety? Chapter 28 (p.361-377) in Yang Y, Taufen A, editors. The Routledge Handbook of Sustainable Cities and Landscapes in the Pacific Rim. Routledge, London. https://doi.org/10.4324/9781003033530
- Liao K-H. Chan JKH, Huang YL. 2019. Environmental justice and flood prevention: The moral cost of floodwater redistribution. Landscape and Urban Planning 189: 36-45. https://doi.org/10.1016/j.landurbplan.2016.01.014
- Hanlon J. 2020. Bangladesh farmers push for temporary flooding to correct Dutch polder failure.

流域與河川治理之自然解方

- IUCN. 2020. Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of NbS. First edition. Gland, Switzerland: ICN.
- Environment Agency (UK): Working with natural processes to reduce flood risk
- Ruangpan L, Vojinovic Z, Sabatino SD, Leo LS, Capobianco V, Oen AMP, McClain ME, Lopez-Gunn E. 2020. Nature-based solutions for hydro-meterorological risk reduction: a state-of-art review of the research area. Natural Hazards and Earth System Sciences 20: 243-270
- Martin EG, Costa MM, Manez S. 2020. An operationalized classification of nature-based solutions for water-related hazards: from theory to practice. Ecological Economics 167: 106460

台灣水文化

- 顧雅文，2022。《尋溯：與曾文溪的百年對話》。經濟部水利署水利規劃試驗所、文化部國立台灣歷史博物館
- 張式慧，2023。第三部：吾水吾土的記憶，社子島的水與生態。廖桂賢主編，《城中一座島：築堤逐水、徵土爭權，社子島開發與臺灣的都市計畫》春山出版社