

出國報告（出國類別：其他）（視訊報告）

參加「第 22 屆世界土壤科學大會」 研討會(視訊報告)

服務機關：行政院農業委員會 農業試驗所

姓名職稱：陳琦玲研究員、許健輝副研究員

視訊會議主辦國家：英國

視訊會議期間：111 年 7 月 31 日至 111 年 8 月 5 日

報告日期：111 年 10 月 11 日

摘要

第 22 屆世界土壤科學大會於英國格拉斯哥(Glasgow)舉辦，本次大會主題為「土壤科學：跨越界線，改變社會」，內容聚焦於土壤與社會之間的關係，為發現這些土壤關鍵全球問題的國際先進專家們提供了理想環境，讓所有從事土壤工作的學者互相交流思想，以聯繫起來。從 111 年 7 月 31 號開始，到 8 月 5 日結束，總計日數為 6 天，共計有 16 大段口頭報告(Oral Section)及 4 大段海報呈現(Poster Section)。陳琦玲研究員的海報於 8 月 3 日 19:30 至 21:30 期間內進行線上發表，標題名為「臺灣生物炭施用對於作物產量及土壤碳匯效益影響之評估」，呈現臺灣在生物炭施用對於作物生產及土壤碳匯影響之研究相關成果；許健輝副研究員的海報亦於 8 月 3 日 19:30 至 21:30 期間內進行線上發表，標題名為「農業生態系服務及提升碳匯之健康土壤管理架構」，呈現本所於農業生態系服務價值目前的研究成果。此外，於會議舉辦期間，亦透過線上方式聽取業務相關的研究發表，瞭解自身的研究議題在國際間發展近況，作為後續研究規劃之參考。

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本文

一、 目的

第 22 屆世界土壤科學大會由國際土壤科學聯合會(International Union of Soil Sciences)主辦，並由英國土壤科學組織(British Society of Soil Science)於英國格拉斯哥(Glasgow)舉辦。本次大會主題為「土壤科學：跨越界線，改變社會」，內容聚焦於土壤與社會之間的關係，涵蓋了土壤系統、土壤處理、土壤管理及全世界的人類如何與土壤互動等範圍。人類 90% 的食物，及日常使用到的木材、纖維等均來自土壤的孕育，而且土壤及其所支持的生態系統，無論在緩解氣候變遷、維持生物多樣性及洪水管理上均扮演重要角色，因此在世界人口成長壓力逐漸上漲的今日，永續利用性的管理土壤變得極其重要。本次大會為發現這些關鍵全球問題的國際先進專家們提供了理想環境，讓所有從事土壤工作的學者互相交流思想，以聯繫起來。

二、議程

Day 1 Programme Sunday 31 July 2022

10:00 - 14:45	IUSS Executive Committee Meeting - <i>closed meeting</i>	Fyne
15:00 - 16:30	BSSS Board Meeting - <i>closed meeting</i>	Fyne
17:15 - 18:00	Press Conference - <i>Invited members of the press only</i>	M3

Opening Ceremony		
18:30 - 19:30	Opening Ceremony	Clyde Auditorium
20:00 - 21:00	Civic Reception	Glasgow Science Centre

Plenary sessions

Title	Speaker	Date	Time	Room
Soils and Sustainable Food Production	Prof Ismahane Elouafi	01/08/22	09:00 - 10:00	Clyde Auditorium
How transforming land use change could change our future	Dr Debra Roberts	02/08/22	18:00 - 19:00	Clyde Auditorium
Rock dust - a reverse weathering mechanism for tropical soils: physical and economic aspects	Prof Suzi Huff Theodoro	03/08/22	17:00- 18:00	Clyde Auditorium
Empowering Soil Scientists with Data-Driven Techniques	Dr Ranveer Chandra	04/08/22	08:00 - 09:00	Clyde Auditorium

Interdivisional Sessions

Session Title	Date	Time	Room	Poster Session
Interdivisional 1: Spatial decision making and mapping for implementing policies for sustainable soil management	01/08/22	11:00 – 13:00	Lomond Auditorium	Poster Session 1
Interdivisional 2 – Soil carbon: from particle to planet	01/08/22	11:00 – 13:00	Clyde Auditorium	Poster Session 1
Interdivisional 1: Spatial decision making and mapping for implementing policies for sustainable soil management	01/08/22	15:00 – 17:00	Lomond Auditorium	Poster Session 1
Interdivisional 2 – Soil carbon: from particle to planet	01/08/22	15:00 – 17:00	Clyde Auditorium	Poster Session 1
Interdivisional 3 – Interdisciplinary soil science for impact	01/08/22	15:00 – 17:00	M1	Poster Session 1
Interdivisional 3 – Interdisciplinary soil science for impact	01/08/22	17:30-19:30	M1	Poster Session 1
Interdivisional 4: Plant soil interactions and their roles in soil formation and sustainable crop production	02/08/22	09:00-11:00	M1	Poster Session 1
Interdivisional 9: Novel methods and techniques	02/08/22	09:00-11:00	Lomond Auditorium	Poster Session 1

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Interdivisional 9: Novel methods and techniques	02/08/22	13:00 – 15:00	Lomond Auditorium	Poster Session 1
Interdivisional 6: Dynamics of soil erosion and land loss under present and future environments	02/08/22	15:30 – 17:30	Lomond Auditorium	Poster Session 1
Interdivisional 7: Soil securing humanity Humanity securing soil	03/08/22	08:00 – 10:00	Lomond Auditorium	Poster Session 2
Interdivisional 8: Sustainable land use	03/08/22	08:00 – 10:00	M1	Poster Session 2
Interdivisional 7: Soil securing humanity Humanity securing soil	03/08/22	10:30 – 12:30	Lomond Auditorium	Poster Session 2
Interdivisional 8: Sustainable land use	03/08/22	10:30 – 12:30	M1	Poster Session 2
Interdivisional 5: Soil science and the emerging philosophy of regenerative agriculture	03/08/22	14:30 – 16:30	Lomond Auditorium	Poster Session 2
Interdivisional 10: Land contamination and degradation, including Urban Land	04/08/22	09:30 – 11:30	Lomond Auditorium	Poster Session 2
Interdivisional 10: Land contamination and degradation, including Urban Land	04/08/22	13:00 – 15:00	Lomond Auditorium	Poster Session 2

Divisional Sessions

Session Title	Date	Time	Room	Poster Session
16 Division 2: Nitrogen cycling and soil health	01/08/22	11:00 – 13:00	Forth	Poster Session 1
16 Division 2: Nitrogen cycling and soil health	01/08/22	15:00 – 17:00	Forth	Poster Session 1
14 Division 1 Commission 1.2: Soil geography: basic science and new technologies:	01/08/22	17:30 – 19:30	Lomond Auditorium	Poster Session 1
24 Division 4 Commission 4.5: History, philosophy and sociology of soil science:	01/08/22	17:30 – 19:30	Forth	Poster Session 1
12 Division: 1 Commission 1.4, Commission 1.6 – Soil classification and palaeopedology	02/08/22	09:00 – 11:00	Boisdale 1	Poster Session 1
12 Division: 1 Commission 1.4, Commission 1.6 – Soil classification and palaeopedology	02/08/22	13:00 – 15:00	Boisdale 1	Poster Session 1

19 Division 2 Commission 2.3: Soil microorganisms under changing environment	02/08/22	13:00 – 15:00	Forth	Poster Session 1
11 Soil Genesis	02/08/22	15:30 – 17:30	M1	Poster Session 1
19 Division 2 Commission 2.3: Soil microorganisms under changing environment	02/08/22	15:30 – 17:30	Forth	Poster Session 1
17 Division 2: Sustainable use of legacy soil phosphorus	03/08/22	08:00 – 10:00	Gala	Poster Session 2
22 Division 3 Commission 3.1 – Soil evaluation and land use planning	03/08/22	08:00 – 10:00	Forth	Poster Session 2
28 WG1.2 – Digital soil mapping: advances towards Digital Soil Assessment	03/08/22	08:00 – 10:00	Alsh 1	Poster Session 2
17 Division 2: Sustainable use of legacy soil phosphorus	03/08/22	10:30 – 12:30	Gala	Poster Session 2
21 Division 3, Commission 3.2 - Soil water, pollutant and gas movement in the context of a changing climate	03/08/22	10:30 – 12:30	Forth	Poster Session 2
13 Division 1 Commission 1.5: How Pedometrics can cross boundaries and change society	03/08/22	14:30 – 16:30	M1	Poster Session 2
21 Division 3, Commission 3.2 – Soil water, pollutant and gas movement in the context of a changing climate	03/08/22	14:30 – 16:30	Forth	Poster Session 2
20 Division 2 Commission 2.3- Soil biology in transition: from descriptive to mechanistical understanding	04/08/22	09:30 – 11:30	M1	Poster Session 2
25 Division 4 Commission 4.4: Soil education – in School, university, and In-Service training	04/08/22	09:30 – 11:30	Forth	Poster Session 2

15 Divisions 1 and 2 Commission 1.1, Commission 2.1- Soil structure - Observation, resilience and its role in ecosystem functioning	04/08/22	13:00 – 15:00	M1	Poster Session 2
18 Division 2 Commission 2.2 – Biogeochemical cycles in the soil - processes linking the abiotic and biotic realms	04/08/22	13:00 – 15:00	Forth	Poster Session 2
IUSS Gender Balance Meeting including Divisional session 26	04/08/22	13:00 – 15:00	Dochart 2	N/A
15 Divisions 1 and 2 Commission 1.1, Commission 2.1- Soil structure: Observation, resilience and its role in ecosystem functioning	04/08/22	15:30 – 17:30	M1	Poster Session 2
18 Division 2 Commission 2.2 – Biogeochemical cycles in the soil - processes linking the abiotic and biotic realms	04/08/22	15:30 – 17:30	Forth	Poster Session 2
23 Division 3 Commission 3.3 – Effects and processes of biochar and soil organic matter on plant nutrition	04/08/22	15:30 – 17:30	Lomond Auditorium	Poster Session 2

Working Group Sessions

Session Title	Date	Time	Room	Poster Session
36 WG2.1: The Legacy of Henry Lin and the future of Hydropedology	01/08/22	11:00 – 13:00	Alsh 1	Poster Session 1
39 WG3.1: General Meeting of the acid sulfate soils working group	01/08/22	11:00 – 13:00	Alsh 2	Poster Session 1
30 WG1.04: Global soil map; main advances and ways forward	01/08/22	15:00 – 17:00	Alsh 2	Poster Session 1
35 WG1.9 – Advances in understanding soils as reflected by the 4th edition of the WRB	01/08/22	17:30 – 19:30	Alsh 1	Poster Session 1
41 WG3.2: Advances in innovative technologies and methods for quantifying biogeochemical cycles of carbon and nutrients in forest soils	02/08/22	09:00 – 11:00	Alsh 1	Poster Session 1
44 WG3.4: Mitigation and adaptation strategies for climate change in rice-based systems	02/08/22	09:00 – 11:00	Alsh 2	Poster Session 1
43 WG 3.4: Recent advances in nutritional, biological and physical processes in paddy soils	02/08/22	13:00 – 15:00	Alsh 1	Poster Session 1
34 WG1.8 – Advances in universal soil classification	02/08/22	15:30 – 17:30	Alsh 2	Poster Session 1

40 WG3.2: Carbon and nutrient cycles under intensifying climate change and land management	02/08/22	15:30 – 17:30	Alsh 1	Poster Session 1
45 WG4.1 - The application of Soil Science in the Criminal Justice System	03/08/22	08:00 – 10:00	Alsh 2	Poster Session 2
29 WG1.3 – Progress in Digital Soil Morphometrics - deeper and more precise soil observations	03/08/22	10:30 – 12:30	Alsh 2	Poster Session 2
37 WG2.2 – Modelling soil processes from ped to global scale	03/08/22	10:30 – 12:30	Alsh 1	Poster Session 2
31 WG1.5: Sensing soil chemical, physical and biological properties - advances and emerging techniques	03/08/22	14:30 – 16:30	Alsh 1	Poster Session 2
46 WG4.2: Culture and Soil. Outlook and insights from around the world	03/08/22	14:30 – 16:30	Alsh 2	Poster Session 2
32 WG1.6: Soil information standards and systems - current initiatives and advances	04/08/22	09:30 – 11:30	Alsh 1	Poster Session 2
38 WG3.1: Acid sulfate soils, sulfidic materials and wetland soils	04/08/22	09:30 – 11:30	Alsh 2	Poster Session 2
33 WG1.7 – Advances in soil monitoring	04/08/22	13:00 – 15:00	Alsh 1	Poster Session 2

Fringe meetings

Session Title	Date	Time	Room
Global Soil Health Programme	01/08/22	13:00 – 19:30	Carron 1
Reaching higher ground: the next generation of soil science through collaborative postgraduate training and learning" everywhere it appears?	02/08/22	09:00 – 13:00	Dochart 1
Soil Benchmark	03/08/22	09:00 – 13:00	Dochart 1
Cranfield Session	03/08/22	12:30-14:30	Dochart 2
Global Soil Health Session 2	04/08/22	09:30 – 13:00	Carron 1
Ecological Continuity Trust (ECT)	04/08/22	09:30 – 17:30	Dochart 1
Sustainability and the World Congress of Soil Science 2022	04/08/22	15:30 – 16:30	Carron 2

AUG 5

12:00am



Closing Ceremony ☆

12:22am – 1:30am

View

時間：2022年7月31日-2021年8月5日

(一) 海報發表

1. 報告時間：Poster Session 2: 8月3日 19:30-21:30

報告標題：臺灣生物炭施用對於作物產量及土壤碳匯效益影響之評估(Evaluation of Biochar Application to Crop yield and Soil Carbon Sequestration in Taiwan)

生物炭是一種鹼性和富碳(carbon-rich)材料，具有改善土壤結構和高碳封存潛力。它可以在土壤中保留碳至少 100 年，增加土壤有機碳(SOC)，並通過提高 pH 值、保持水分和養分促進作物生長。本研究旨在評估生物炭對臺灣小白菜(*Brassica chinensis*)產量和土壤固碳的影響。根據之前 6 處農業試驗地點對 38 種生物質炭的盆栽研究，酸性土壤中施用 2% 生物炭可提高小白菜產量 5-23%。田間試驗也呈現類似的結果。然而，若施用生物炭於鹼性土壤中，碳固存將減少。臺灣的酸性土壤 (pH<5.5) 約為 30 萬公頃，若在所有強酸性土壤中施用 2% 的生物炭，預計土壤碳固存量將增加約 420 萬公噸。除了作物產量和土壤碳匯效益外，生物炭的應用在某些條件下還可以減少土壤溫室氣體排放。若每年施用 2% 土壤炭於 2000 公頃農地上，土壤碳匯效益可每年增加 0.1%。

2. 報告時間：Poster Session 2: 8月3日 19:30-21:30

報告標題：農業生態系服務及提升碳匯之健康土壤管理架構(A Framework of Healthy Soil Management for Agricultural Ecosystem Services and Enhanced Carbon Sinks)，該報告與臺灣大學生工系共同發表。

永續農業管理為廣泛被討論的議題，其涉及氣候變遷、糧食安全及資源保育。一些國家陸續將生態系統服務功能納入其農業政策，並將其納入農業政策並開發了量化工具，為農民提供合理的補償。農田土壤可以提供許多重要的生態系統功能，例如糧食供應、水質淨化、持續性的養分循環、生物棲息地供應和碳匯。然而，由於農業生態系統服務仍被排除在經濟決策系統和市場之外，台灣的農田正面臨著因經濟發展增長而引起土地利用變化的重大挑戰。因此，本研究旨在發展可持續的農業策略，以保護生態系統服務，同時提升土壤碳匯。首先，我們提出健康土壤管理的評估架構，接著透過量化方法和工具來估計農業生態系統服務的功能。最後，我們提供了一個案例研究來證明農業生態系統服務和土壤碳匯的價值，作為未來執行永續性土壤管理參考。

三、心得

本次研討會發表內容摘要如下，可做為我國淨零及土壤管理相關措施擬定的參考：

(一) 健康的土壤是緩解糧食不安全的根本原因，而當地糧食生產可持續是一個可行的解決方案，但目前需要解決的問題在於財務來源和法律相關支持與協調，且要如何在尊重環境可持續性的同時保持並提高土壤生產力。土壤科學界肩負重要的責任，根據成功的經驗和數據提供可行的解決方案。

- (二) 借鑒政府間氣候變化專門委員會(Intergovernmental Panel on Climate Change, IPCC) 報告的結果：全球升溫 1.5°C、陸地海洋和北極圈的氣候變化，以及正義和公平等問題，回顧土地利用變化在推動和應對當前氣候變化挑戰方面的作用。
- (三) 巴西位於風化過程強烈的熱帶地區，淋溶作用強導致自然肥力下降。儘管該地土壤被認為是一種無限資源，但它們已經受到綜合農業的企業模式強烈轉變，加速侵蝕過程和造成表層有機物質的損失，並削弱其生產能力。另外，為確保提高生產率，巴西使用大量進口可溶性肥料、資本密集型技術及對巴西產品的強大國際需求等這些條件，使巴西成為農業綜合企業領域的重要世界參與者。但這種狀態可能不會長久，因為化肥價格連續上漲，使資金較少的農民無法獲得所需化肥數量，此外，將天然林轉變為牧場或農業區對全球輿論產生了負面影響。在巴西出現的一種良好的替代方案，是使用石粉技術(stonemeal technology)作為土壤再礦化劑。在過去 20 年中，多項研究證明了使用某些種類的地面岩石來改變熱帶土壤肥沃度的有效性。此外，使用石粉技術可作為較低成本的應用，且具有恢復退化地區的潛力，並將數千個非生產性地區轉變為多種用途，包括二氧化碳封存和儲存能力等。此種作法在巴西不同地區已取得許多積極的生產成果，同時提升巴西農民的創新形象，使巴西成為第一個通過法律法規建立國家土壤再礦化劑的使用和商業化的國家。
- (四) 土壤科學需要精心設計的測量、複雜的傳感器、物理土壤檔案和模型等因素而得測量，使得上個世紀在了解土壤物理、化學和生物特性方面取得了驚人的發現。然而，缺乏大尺度測量將使研究人員無法對土壤進行大規模分析，限制了對動態土壤特徵的理解。最新發展的雲端和人工智能等技術可使土壤科學家對土壤產生新的認識並創造突破性發現，研究人員能使用物聯網(IoT)收集以前不可用的數據，並儲存於雲端，在近代可運用人工智能來發現土壤的新特性或是聯想到對未來影響的推理。
- (五) 目前土壤科學緊要的討論議題包括：(1) 碳固存效率的最佳估計值有多穩健？並且社區可以在關鍵模型中做出多少更透明且可測試的假設與參數？(2) 氣候變遷及正向的土壤碳回饋將如何影響土壤碳匯預估值？(3) 在土壤的新興議題中，社區和科學機構如何在商業與宣傳之間創建足夠的防火牆？(4) 自然科學學者如何與相關的社會科學合作，以防止難以置信的事情合法化，並根據不實用的技術方案來擬定政策？
- (六) 樹木及作物的根部在為獲取資源而覓食時，根部確實會釋放大量有機化合物，並顯著改變養分濃度和土壤 pH 值，因此根已經進化出多種覓食策略，依賴於在活根周圍附近尺度發生的根際過程組合。這些最終決定了土壤有機物質、土壤礦物質的溶解與沉澱，以及陰離子(例如磷酸鹽)和陽離子(例如鉀)的吸附，從而支持土壤形成等過程。在本次演講中，我們描述對於碳匯效益最有貢獻的作物及樹木，以及為了將來農業生態系進行作物營養循環令人興奮的一面。

四、建議

- 1.在今年的世界土壤科學大會中，聆聽國際土壤相關專家學者從各專業領域對於土壤科學的未來發展與盼望，獲得許多實際幫助，在面對氣候變遷即將帶來的饑荒，我們的確該設想可行的解決方案來維持永續性的健康土壤管理方式，以維持良好的糧食生產。
- 2.建議未來在淨零及土壤管理擬法時，可參考與臺灣有同樣小農耕作問題之國家應對方案，進行相關措施擬定。

附錄、會議照片

Evaluation of Biochar Application on Crop yield and Soil Carbon Sequestration in Taiwan

In Taiwan application of biochar on farmland has the highest soil carbon sequestration than other agriculture practices. It can increase soil organic carbon (SOC) and also improve crop growth by increasing pH, maintaining water and nutrients in soil.

Biochar application

- About 300,000 ha strong acid soil (pH<5.5) in Taiwan.
- The total amount of biochar application will be need about 12 million Mg if 2% biochar applied in all of the strong acid soil.

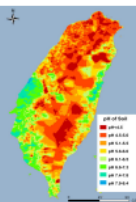


Fig.1 Distribution of strong acid soil in Taiwan.

Increasing the crop production

- Biochar applications is indirectly helpful crop growth by increasing pH, water and retention nutrient in the soil.
- Applying 2% biochar in pot cultivation of *Brassica chinensis* in 6 agricultural areas, the yields were increase 5-23% in acid soils areas (Fig.3).




Fig.2 Distribution map of 6 agricultural areas




Fig.3 The yield of *Brassica chinensis* with applying 2% biochar in pot cultivation in different agricultural areas.

Soil carbon sequestration by biochar application

-Soil carbon mineralization incubation-

- Biochars from 9 different feedstock and pyrolysis temperature (400°C, 500°C, 600°C) have been added to two representative soils in Taiwan.
- Pc-soil (acidity laterite)
- Ec-soil (slate calcareous older alluvial soils)

Table 1. Soil properties.

Characteristics	Pc-soil	Ec-soil
pH	6.3/5.0*	7.5/7.3*
EC (dS m ⁻¹)	0.45**	2.21**
Sand (%)	11	24
Silt (%)	30	36
Clay (%)	59	39
Soil Texture	Clay	Clay loam

➢ Biochar addition has positive effect of reducing soil carbon mineralization and soil carbon sequestration in Eh-soil. Especially adding the biochar with pyrolysis temperature of 500°C and 600°C.

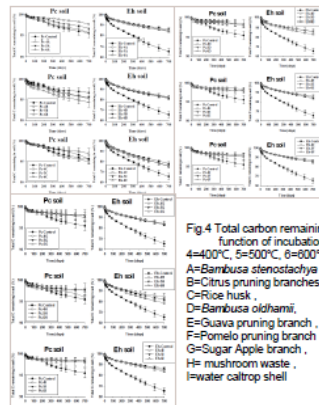


Fig.4 Total carbon remaining as a function of incubation time 4=400°C, 5=500°C, 6=600°C. A=Bambusa stenostachya, B=Citrus pruning branches, C=Rice husk, D=Bambusa oldhamii, E=Guava pruning branch, F=Pomelo pruning branch, G=Sugar Apple branch, H= mushroom waste, I=water caltrop shell

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- Biochar can retain 70% carbon in soil at least 100 years.
- The soil carbon sequestration is expected to increase about 4.2 million Mg if 2% biochar applied in all of the strong acid soil.

圖 1. 陳琦玲研究員報告「臺灣生物炭施用對於作物產量及土壤碳匯效益影響之評估」海報內容

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**Evaluation of Biochar
Application to Crop yield and
Soil Carbon Sequestration in
Taiwan** ☆

 1000

Chi-Ling Chen

Poster Session 2: Even Numbers

Aug 3 7:30pm - 9:30pm

Presenter Gallery [View All](#) 


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圖 2. 陳琦玲研究員報告「臺灣生物炭施用對於作物產量及土壤碳匯效益影響之評估」會議截圖

A Framework of Healthy Soil Management for Agricultural Ecosystem Services and Enhanced Carbon Sinks

LIN, Kuan-Ting¹; SYU, Chien-Hui²; CHANG, I-Ting²; LIU, Tsang-Sen²; GUO, Ling-Yi²; PAN, Shu-Yuan¹; GUO, Hong-Yuh²
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National Taiwan University
 國立臺灣大學



Introduction

This study aims to develop sustainable agricultural strategies for protecting ecosystem services while enhancing soil carbon sinks. We firstly propose the evaluation framework of healthy soil management, and then summarize the quantification methods to estimate agricultural ecosystem services. We also collect local agricultural and environmental data, such as the soil dataset from the Council of Agriculture in Taiwan. With the availability and accessibility of data, we establish an evaluation framework for agricultural ecosystem service. Lastly, we provide a case study to demonstrate the non-market value of agricultural ecosystem service and soil carbon sinks as a sustainable soil management reference for future related strategic planning and decision-making systems.

Method

1. Selection of Ecosystem Service

- Analyze the ecosystem service and its indicators in agriculture
- Select for healthy soil management

If no available or accessible data

2. Collect the Data

- Research the dataset of soil, agriculture, land, and environment

3. Establish the Evaluation Framework

- Identify calculation methods for the selected ecosystem services: INVEST model or on-site measurement
- Demonstrate and Mapping a Case Study in Taiwan

2. Collect the Dataset

Table 2. Agricultural and Soil Ecosystem Related Data

Data Layers	Ecosystem Service	Source	Year
Rice Yield Map	Food Provision *	TARI	2021
Soil Organic Carbon	Carbon Storage *	TARI	2015
0-30 cm Topsoil Texture	Water Retention	TARI	2016
Agricultural Land Use Data	All	COA	2019
River Basin Range Map	Nutrient Retention	WRA	2003
Monthly Average Rainfall	Water Retention	NCDR	2020
Grid Data	Nutrient Retention		
20M Grid DTM	Nutrient Retention	MOI	2020

* ESSs that be can calculated by on-site measurement.

3. Evaluation: Case Study in Yunlin, Taiwan

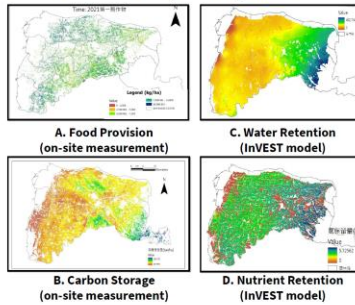


Figure 1. Mapping of Soil Ecosystem Services

Current Results

1. Ecosystem Services for Soil Management

Considering the need for the healthy soil management issue and the availability of dataset, we select the one provision service (food provision), and three regulation services (carbon storage, water retention, and nutrient retention).

Table 1. Soil Ecosystem Services and Indicators

Ecosystem Service	Indicators
Food Provision	Rice Crop productivity (tons / m ²)
Carbon Storage	Soil organic carbon content (tons / m ²)
Water Retention	Water retention volume (m ³ / m ²)
Nutrient Retention	Nitrogen and phosphorus retention quantity (m ³ / m ²)

Conclusion and Future Work

For healthy soil management and enhancement of carbon sinks, we proposed an ecosystem service framework. The ecosystem services in soil and farmlands include food provision, carbon storage, water retention, and nutrient retention. In the future, the framework can be integrated into strategic planning and decision-making systems in the regional level.

圖 3. 許健輝副研究員與臺灣大學生工系共同發表「農業生態系服務及提升碳匯之健康土壤管理架構」海報內容

(A)

The screenshot shows a virtual event page for 'Interdivisional 9: Novel methods and techniques' starting at 4:00pm. The main content area features a slide titled 'Dataset: Spectral data' with a table and four line graphs. The table lists spectrometers and their corresponding wavelength ranges and observation counts.

Spectrometer	Wavelengths range (nm)	Number of observations
Tensor (min)	749.6 – 599.8	3603
Alpha I	3996.4 – 499.9	1715
Alpha II	3996 – 499.2	1708
Invenio	7496.3 – 599	4840

The right sidebar includes a timer showing 54m remaining, a 'Next activity' button, and a 'Live Q&A' section with a 'Submit' button. The event is part of the Glasgow 2022 World Congress of Soil Science.

(B)

The screenshot shows a virtual event page for 'Interdivisional 6: Dynamics of soil erosion and land loss under present and future environments' starting at 10:30am. The main content area features a slide titled 'A crop phenology-based approach to quantify the C-factor at the field-parcel scale in Europe' by Francis Matthews. The slide includes logos for KU Leuven, European Commission, and IRMA ATRE.

The right sidebar includes a timer showing 1h 24m remaining and a 'Session Information' section with speaker details for Francis Matthews and Hari Ram Upadhayay. The event is part of the Glasgow 2022 World Congress of Soil Science.

圖 4. 2022/8/2 線上聽取「Interdivisional 9: Novel methods and techniques」(A)及「Interdivisional 6: Dynamics of soil erosion and land loss under present and future environments」(B)口頭報告照片

(A)

WCCS2022 Virtual Event Pl...
portalapp.speakeasy.eventsair.com/VirtualAttendeePortal/wccs-2022/wccs2022/

Interdivisional 7: Soil securing humanity | Humanity securing soil ☆
3:00pm - 5:00pm
LIVE NOW 2

1h 57m
Next activity 1h 57m

Session Information

Interdivisional 7: Soil securing humanity | Humanity securing soil Speakers

Agroecology and healthy soils to ensure food security and sovereignty

Cristine Muggler
Voluntary Professor
Federal University of Viçosa, Brazil
Cristine Muggler is Voluntary Professor at the Soil Science Department of Federal University of Viçosa (UFV), Brazil, and UNESCO consultant for the New Expositions of the National Museum of Brazil. She is geologist, PhD in Environmental Sciences and postdoc in Soil Education and public awareness at the World Soil Museum.

Assessing countries' commitments for soil organic carbon protection and sequestration under the three Rio Conventions

Liesl Wiese-Rozanov
International Consultant
Independent Consultant
I work as an independent international consultant in agricultural science and policy. My technical focus is on soil organic carbon in relation to food security, food and food production, as well as land degradation.

(B)

WCCS2022 Virtual Event Pl... haplotypes 中文 - Google Search | +
portalapp.speakeasy.eventsair.com/VirtualAttendeePortal/wccs-2022/wccs2022/

Interdivisional 5: Soil science and the emerging philosophy of regenerative agriculture: ☆
9:30pm - 11:30pm
LIVE NOW 72

26m
Next activity 26m

Evaluating Soil Health Practices at Field Scale
NDSU EXTENSION
Abbey Wick
North Dakota State University
Fargo, ND, USA

A tree against hunger: Enset-based farming systems for building soil health in the tropics

Karen Vancampenhout
Professor
KU Leuven
Dr. Vancampenhout is a Professor of Soil Science at the University of Leuven. She specialises in soil organic carbon dynamics in natural and agricultural systems and in combatting land degradation in Europe and the tropics. She is the president of the Soil Science Society of Belgium.

Crop Diversification and Soil Health in Dryland Wheat-Based Agroecosystems in the Inland Pacific Northwest USA

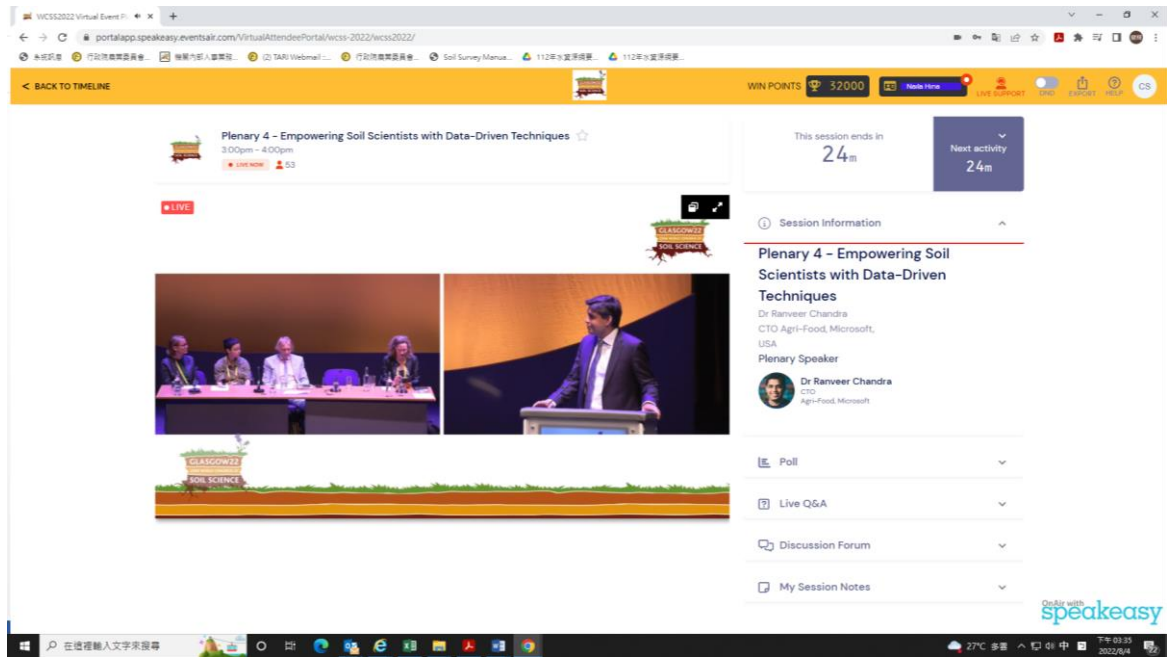
Jodi Johnson-Maynard
Professor and Head
University of Idaho

Evaluating Soil Health Practices at Field Scale

Abbey Wick
Associate Professor and Extension Specialist
North Dakota State University
Dr. Abbey Wick, North Dakota State University Associate Professor in Extension, has experience working with farmers on soil health building practices like incorporating cover crops into rotation and transitioning to no-till systems. She focuses on goal-oriented approaches to help farmers maximize benefits while reducing risk associated with climate change.

圖 5. 2022/8/3 線上聽取「Interdivisional 7: Soil securing humanity | Humanity securing soil」(A)及「Interdivisional 8 - Sustainable land use」(B)口頭報告照片

(A)



(B)

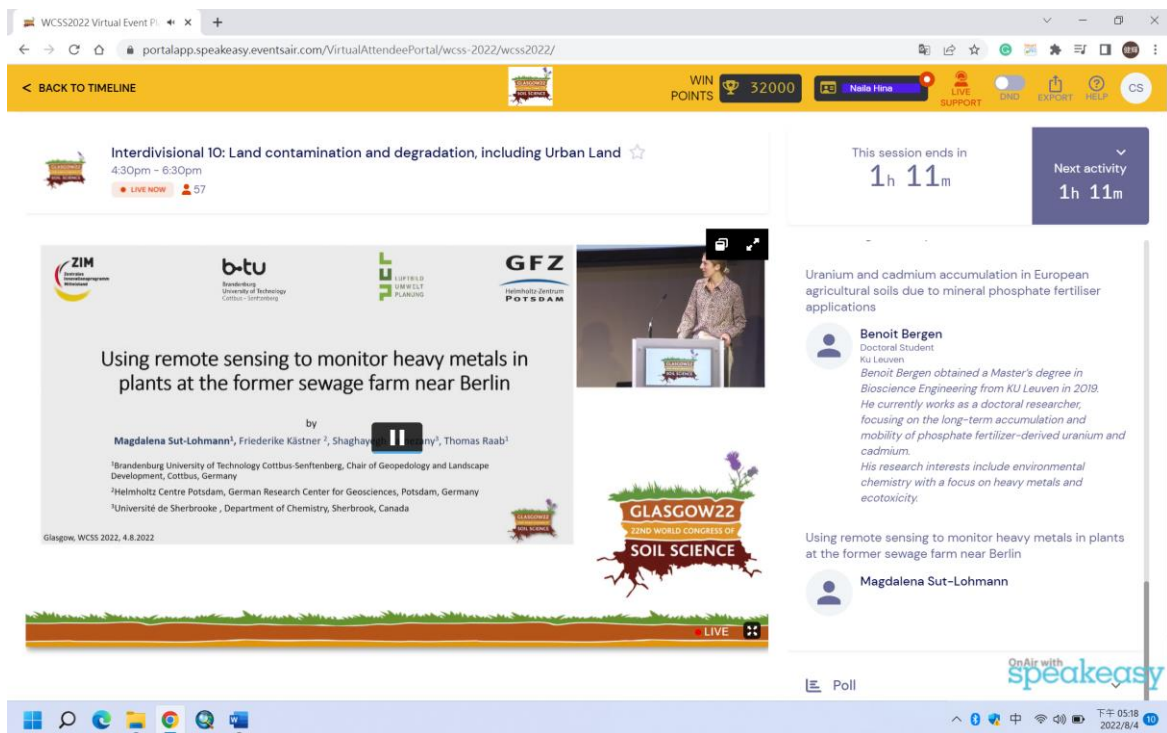


圖 6. 2022/8/4 線上聽取「Plenary 4 - Empowering Soil Scientists with Data-Driven Techniques」(A)及「Interdivisional 10: Land contamination and degradation, including Urban Land」(B)口頭報告照片



Certificate of Attendance

This is to certify that

Researcher Chi-Ling Chen

attended The World Congress of Soil Science 2022, which took place in Glasgow from 31st July - 5th August 2022

Bruce Lascelles
BSSS President,
Chair of WCSS22



圖 7. 第 22 屆世界土壤科學大會陳琦玲研究員參與證書



Certificate of Attendance

This is to certify that

Dr Chien-hui Syu

attended The World Congress of Soil Science 2022, which
took place in Glasgow from 31st July - 5th August 2022

Bruce Lascelles

*BSSS President,
Chair of WCSS22*



圖 8. 第 22 屆世界土壤科學大會許健輝副研究員參與證書