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執行機關(計畫)識別碼:070101e502

# 農業部林業及自然保育署112年度科技計畫研究報告

國際生態工程學會(IEES)研討會資料 蒐集研究案(國立中山大學)(第1年/全程 計畫名稱:

(英文名稱) Research Proposal for Data

Collection at International

Ecological Engineering Society (IEES) Conference (National Sun

Yat-sen University)

112農科-7.1.1-務-e5(2) 計畫編號:

自 112年9月1日 至 112年11月30日 全程計畫期間: 本年計畫期間: 自 112年9月1日 至 112年11月30日

計畫主持人: 林巧雯 研究人員: 邱子潔

執行機關: 國立中山大學





# 一、執行成果中文摘要:

此計畫案將參與2023/10/1~2023/10/5於希臘哈尼亞舉辦國際生態工程研討會 (International Ecological Engineering Society Conference),在" Climate change, green and just transition, and carbon neutrality: the role of ecological engineers"的主題,分享臺灣欖李紅樹林溫室氣體排放與碳匯能力之最新成果。並瞭解最新的生態工程研究發展、技術,蒐集可應用於林業及自然保育署研究主題之生態工程資料。期望在未來臺灣生態工程領域與應用自然解方於淨零碳排研究有所貢獻,提升紅樹林生態系統所提供的碳匯服務功能。

# 二、執行成果英文摘要:

This project aims to participate in the International Ecological Engineering Society Conference scheduled from October 1st to October 5th, 2023, in Chania, Greece. Under the theme "Climate change, green and just transition, and carbon neutrality: the role of ecological engineers," we will share the latest findings on greenhouse gas emissions and the carbon sink of Taiwan's Lumnitzera racemose mangroves. Furthermore, we aim to gather insights into the latest developments and technologies in ecological engineering and collect data applicable to Forestry and Nature Conservation Agency. Our objective is to contribute knowledge to ecological engineering and apply natural-based solutions to achieve carbon neutrality, thereby enhancing the ecosystem services provided by mangroves in Taiwan.

# 三、計畫目的:

- (一) 分享臺灣紅樹林碳匯經驗與成果,並探討紅樹林應用於生態工程與氣候變遷調適之議 題。
- (二)學習國際生態工程的專業知識與最新趨勢。
- (三) 蒐集國際生態工程的相關資料。

## 四、重要工作項目及實施方法:

研討會舉辦地點於歐洲希臘哈尼亞(Chania),日期為2023/10/1-2023/10/5,研討會網址: https://www.iees.tuc.gr/key-dates/, 議程如附件,

## 主題包含以下八種類別:

- Use of ecological elements and ecosystems to reduce pollution
- Use of ecosystems in a circular society
- Circular design and integrated planning approaches for increased resiliency
- Resource recovery and reuse
- Climate change, green and just transition, and carbon neutrality: the role of ecological engineers
- Regenerative agriculture
- Ecological Engineering and the mining industry
- Ecological Engineering Education





本次發表的論文所屬主題為" Climate change, green and just transition, and carbon neutrality: the role of ecological engineers", 該主題包含以下子項:

- From the Green Deal to the Real Deal
- Energy-saving technologies
- Eco-engineering for energy efficiency
- Bioenergy, biomass to fuel
- Microbial fuel cells
- Bio-sequestration, soil-carbon sequestration
- Industrial ecology
- Environmental impact assessment
- Life-cycle assessment
- Social life cycle and impact assessment
- Stakeholders' engagement and citizen participation
- · Capacity building and living labs
- Environmentally-focused social innovation

其中" Bio-sequestration, soil-carbon sequestration"這個主題更與臺灣淨零碳排最為相關,

本次研討會分享的成果為欖李紅樹林生態系統溫室氣體排放對其碳匯的影響(摘要如附件與接受函)。除了分享相關研究,視議程安排,預計將蒐集與林業及自然保育署相關的研究主題資料,如" Use of ecosystems in a circular society:Nature-based solutions: e.g., green roofs, green walls, rain gardens, green facades, vertical gardens, bioretention systems, microalgae culture, rainwater harvesting, urban forests, swales, soakways, green/blue corridors, drain ways, participatory watershed management, coastal mangrove restoration, etc.)"以及"Regenerative agriculture:Sustainable forest management"。

期望透過此次參訪,瞭解最新的生態工程研究發展、技術,並將成果應用於臺灣生態工程與氣候變遷調適。

#### 五、結果與討論:

在IEES研討會中,計畫主持人以及研究生進行分享的主題為: Greenhouse gas emissions from *Lumnitzera racemosa* mangroves,本研究團隊順利完成海報發表,並和與會的專家學者進行相關議題的討論(如附件一)。

除了分享臺灣紅樹林碳匯經驗與成果,並探討紅樹林應用於生態工程與氣候變遷調適之議題,並蒐集了國際生態工程的專業知識與最新趨勢,會議議程如附件二。

#### Keynote speaker session (2023.10.2):

研討會第一天的Keynote演講是Dr. Fabio Masi,主題是"Nature-based Solutions for Wastewater Treatment and Application of Circular Economy strategies",主講者首先提到農田過多的氦肥與磷肥排入水域環境中,造成嚴重的環境問題,加上因為戰爭的關係,磷的價錢也逐年增加,因此如何農業如何合理化施肥就變得相當重要。此外,主講者還提到氣候變遷造成的危機,包含:生物多樣性的流失、洪水與乾旱事件頻率的增加、熱島效應的情形日益嚴重、水質的惡化等,因此水資源的循環再利用也成為聯合國永續發展目標Sustainable Development Goals (SDGs)重要的議題之一。而人工濕地(Constructed Wetlands, CWs)成為





有效利用水資源(水循環)的Nature based solutions (Nbs) (以自然為基礎的解方),人工濕地的功能除了有增加生物多樣性、洪水調節、景觀與地景、水質淨化等功能,甚至還包含熱島效應調節、二氧化碳儲存,因此對氣候變遷的調適佔有很重要的角色。講者也介紹綠屋頂的設置,除了增加城市的綠美化、減少熱島效應,更可提升都市的生物多樣性,提供昆蟲(如:蝴蝶)及鳥類棲息地,並可直接處理住宅或者商用辦公大樓的污水。最後,講者強調Nature based solutions可以成為人類與自然永續發展的重要方法。

# Session A3: Resource recovery from water

"Production and recovery of orthophosphate from phosphonate-contaminated wastewater combining ozonation and ultraviolet advanced oxidation processes" 這個 主題是在探討,由於污水中的磷過多,易造成水域優養化,此研究運用臭氧以及紫外線氧化的 方式,分解污水中的有機和無機污染物,以提高污水中磷酸鹽的回收效率。結果顯示,水中正磷酸鹽的回收率可以高達90%,且此方法可以應用於酸鹼值範圍大的污水,因此此技術也許能 應用於污水處理廠。

" Exploring the potential of cyanobacteria microbiomes for sustainable bioproducts" 這個主題是在探討藍綠菌群在永續生物性產品的潛力,將二級處理放流水作為養分提供給藍綠菌生長,淨化的水再次變成可利用水源,同時產生生物質製成生物性產品(如:塑膠、顏料),剩餘的再經厭氧消化作用製成生質能源或生物肥料。若經濟、技術許可的話,這會是一個很好的發展方向,不僅可以達到廢水處理的作用,更能利用其副產物取代石化產品,且光合作用菌(ex:藍綠菌)有吸存二氧化碳的功能,進而減少碳排放,可達到一個雙贏的目標。

" Electrocoagulation flotation treatment technology in perspective of resource recovery and reuse of municipal wastewater in different regions of the world" 是利用電混凝浮除法對廢水進行回收及再利用,講者所在的孟加拉庫爾納市並沒有任何污水處理廠,因此排出的廢水因含有高濃度的營養鹽和重金屬,會對下游的紅樹林棲地造成影響。臺灣或許也有部分村落是沒有污水處理設備的,甚至可能有工廠私自排放廢水的隱患,因此在紅樹林保育的部分可能也要進行附近水域、河川的水質監測。

#### Session A4: Novel designs of Constructed Wetlands

"The Integrated constructed wetland design approach: A 35- year review",愛爾蘭研究員Dr. Harrington分享人工濕地35年的回顧,提到Dunhill village wastewater treatment wetland (ICW) complex的案例,該區域在1988年經過"Re-wetting & Reforesting (將土地改為濕地並植林)",提供了許多生態系統服務,包含:生物多樣性、水資源管理、地景景觀美化,此外,該濕地吸收了許多營養鹽(氮、磷),更具有碳吸存的功能,包含入流以及大氣碳吸存,每年約吸存3700 kg C/ha。

"Efficiency removal of specific substances in multistage treatment wetland for urban drainage water",波蘭的講者分享的是人工濕地應用於城市排水系統,由於降雨逕流流經城市後,會污染下游的水域,污染源包含:有機污染物、重金屬、塑膠微粒、總懸浮固體 (Total suspended solids, TSS)等,於城市排水系統內建造人工濕地,不儘可以降低水體的濁度、總懸浮固體、化學需氧量(Chemical oxygen demand, COD)濃度,針對塑膠微粒如聚乙烯(polyethylene)、聚丙烯(polypropylene)、醇酸樹酯(Alkyd)的移除率分別為96.8%、99.4%、99.9%,移除率相當高。





"Performance of pilot-scale constructed wetlands with different designs and substrates treating olive mill wastewater",希臘的講者提到由於橄欖油為希臘的特產,因此有許多提煉橄欖油的工廠,然而橄欖油的製成產生的廢液有著以下特徵:腐敗的味道、酸鹼值偏低、高導電度、高化學需氧量、高濃度的酚(phenolic),因此會污染水域環境,研究人員建造了一個人工濕地的小型模廠,於人工濕地裡種植蘆葦,結果發現COD、phenolic、Total nitrogen的移除率分別可高達57~90%、40~84%、60~70%。

#### Session A9: Circular water economy

Greywater treatment and reuse in a residential building in Zurich, Switzerland: Evaluation of the treatment performance and user acceptance",一位瑞士的講者講述家庭廢水可視為是一種持續性的水源,很適合用來回收或再利用,但他的研究只有將這些廢水經過簡單的生物處理而已,無法達到自來水標準,但符合一般水源的標準。家庭廢水處理後是否可以廣泛被大眾接受這個議題在瑞士有2/3的受訪者是可以接受的,絕大部分的人可以接受這些再利用的水用來沖馬桶或是澆花。在台灣也會是一個很好的省水方法,家庭廢水很難大幅減量,若可以再利用,將能避免水資源浪費。在臺灣乾濕季明顯的地區更可以盡早引進類似的技術,減少旱季帶來的不便以及可能產生的病害。

## Keynote speaker session (2023.10.3):

研討會第二天的Keynote演講是Dr. Nikolaidis,主題是" Nature-based solutions to optimize the Water-Ecosystem-Food Nexus at the basin scale",研究地點是在希臘的 Koiliaris Critical Zone的長期研究站,這個研究站蒐集了以下資料:水文氣象、土壤(生物、地質化學、組成、分解、肥料含量)。講者提到土壤的生態系統服務包含:種植農作物、生物多樣性、碳吸存、水分傳輸等,然而由於種植農作物,施灑肥料與灌溉使得農田土壤的物理、化學、生物特性產生改變,且在不瞭解土壤的物理化學特性的情形下,容易造成肥料與水資源的浪費,因此該研究人員於研究站內的酪梨農場使用土壤張力計與單環實驗分析土壤的入滲率,藉以達成合理化(最適化)的灌溉用水,結果顯示2022年,用水為5.5 m³/tree。

#### Session B2: Green roofs and walls

"Proposing a holistic experimental setup for green roof flammability testing"這個主題是在測試綠屋頂的易燃性,主要考慮燃燒速度、易燃程度、消耗性、可持續性等。由結果可知火焰蔓延與水分含量與樹冠層縫隙大小有關。目前臺灣也有建物綠化的補助或是規定,有綠屋頂或牆的建築物越來越普遍,因此在種植綠屋頂植物時,除了植物種類選擇之外,仍需考慮植物種植密度及含水量等因子,避免在火災發生時,變為最好的燃燒媒介,導致火勢蔓延加快。

"Performance of three ornamental species for indoor living walls irrigated with greywater"是在探討三種室內生活牆用灰水灌溉的觀賞植物種類-波士頓腎蕨、心葉蔓綠絨、彎穗苞葉芋的性能。生活牆是為了在都市有限空間中依舊能有一些綠意而建立的,某些地區常有缺水的情形,家庭廢水可以作為澆水的水源,經過生活牆生物過濾之後水質也可以得到改善。在實驗結果中,使用廢水或自來水並不影響植物生長,廢水水質也可以有大幅的改善,且在不同物種間並沒有太大的差異。和Session "Circular water economy"提到的相同,可以發現更多家庭廢水的使用方向,實現開源節流的省水方式。

## Session B5: Bioenergy, Renewable energy systems and energy efficiency

"Carbon neutrality of energy produced from woody biomass" 在說明木材生質能源的碳中和性。木材生質能源在歐洲總能源中佔比不大,但可能會是許多國家重要的能源組成成分。



比如在北歐國家或奧地利等地區提供熱量、產生電能,可以減少化石燃料的使用。在臺灣並沒有太多木材可以作為生質能源,但或許可以使用廢棄木材來作為能源,燃燒銷毀之外,還能有其他可利用之處。

"Effect of environmental factors on dust accumulation and the efficiency of photovoltaic panels: A study case in an Andean City" 這個主題在探討環境及粉塵對光電板產生的影響。太陽能及風能佔全球能源的10%以上,但空氣污染及天氣會造成粉塵累積,使光電板壽命減少。由結果可知,在粉塵多時,能源效率會些微降低,也會因為降雨產生變化。臺灣由於2050淨零碳排之政策,大量興建光電板,但在光電板選址的部分除了底質之外,仍需考慮氣候、周邊環境是否會造成粉塵等因素,才可達到最大的效能。

"Forest conversion and GHG emission in screening and EIA procedures regarding PV systems in Croatia" 則是討論當克羅埃西亞的森林轉換為太陽能光電板溫室氣體排放的影響,結果顯示,該研究森林區域原有面積約為34,601公頃(ha),將森林砍伐後,轉換為太陽能光電板發電場域後雖可發電43,116 GWh,然而卻有350 tonne/ha排放。因此建立太陽能系統時,環評中需考慮森林轉換與溫室氣體排放的關係。近年來,臺灣有許多土地轉換為光電板發電廠,然而土地轉換對溫室氣體排放的影響卻鮮少有資料,特別是濕地與森林的棲地,因是自然碳匯的重要場域,更應審慎評估。目前部分歐盟國家在進行環評時會考慮溫室氣體排放,臺灣也許可以效仿。架設光電板初期可能會進行森林砍伐、翻土等作業,這會導致大量溫室氣體釋放,任何土地利用轉變都會造成溫室氣體排放量的不同。因應減碳趨勢,未來可以將土地利用轉變所造成的溫室氣體排放(碳排放)影響納入環評的檢測項目中。

# Session B8: Constructed wetlands applications

" Efficiency of pilot scale constructed wetlands with various substrates for landfill leachate treatment"探討的是人工濕地中,不同濾料介質的應用對水處理效率的影響,希臘研究團隊使用高回收的密度聚乙烯(RHDPE)、橄欖樹樹枝做成的生物炭(Biochar)、礫石的組合,探討人工濕地水質改善情形,結果顯示生物炭可以加速濕地植物生長,並且有效的移除氦,RHDPE能過有效的過濾TSS,而不同的濾料組合結果顯示,RHDPE和生物炭的濾料有較高的污染物移出率。

#### Session B9: Ecological restoration

"Phytocap soil density specification for optimum plant water use and root growth"主要是研究最適合植物根系生長及水分利用的土壤密度。植物覆蓋技術是在垃圾掩埋場等受污染土地上種植植物,以減少污染物滲漏並提高土地可利用性的一種技術,使用堆肥、生物碳、厭氧消化等方式進行,可以改善貧瘠土壤。在臺灣也有許多荒廢土地或是土壤不夠肥沃的狀況,若能善用植物覆蓋技術,恢復退化的土壤,將能大幅減少閒置土地的數量,也能同時提高農民產量。

#### Session B10: NBS for climate change adaptation

" Integrating Yami/Tao traditional ecological knowledge into ecology education - an exemplification of Nature-Based Learning",臺灣台東大學的呂佩倫博士分享透過教育新一代蘭嶼達悟族原住民傳統文化並結合生態教育,有助於生態環境永續的發展,以及傳統活動"飛魚祭"的傳承。

#### 六、結論:





# 綜合心得:

# 計畫主持人:

這次參與IEES會議,由於本人的研究與紅樹林碳匯功能、氣候變遷調適有關,與各國學者分享臺灣紅樹林碳匯與溫室氣體排放的成果,也有來自哥倫比亞的學者分享該國紅樹林作為因應氣候變遷之自然解決方案,而會議中不同面向的生態工程研究主題,讓我學習到許多除了自己領域外,寶貴的知識。此生態工程國際會議的主軸是"Nature-based solution",因此與會的主題涵蓋甚廣,其中人工濕地被視為水質改善、提升生物多樣性、碳吸存的自然解方。人工濕地雖然都以水生植物為主,但國外的研究顯示,在人工濕地周圍種植樹木,不僅可以增加碳匯功能,也可增加生物多樣性。此外,有學者分享廢棄的木材,也可循環再利用,成為人工濕地濾料的生物炭。而人們熟知的綠屋頂,除了具有淨化民生用水的功能,也提供城市生物的棲息地,而有學者更提出綠屋頂種植樹木的可能性。歐美也有將森林轉換為光電板後,對溫室氣體排放的影響。也有研究人員分享人工濕地模場在研究過程中,實驗模場被偷竊破壞,導致實驗中斷等甘苦談。上述這些國外經驗與研究,都可以成為日後臺灣森林保育、人工濕地建置、綠屋頂發展的借鏡。

#### • 研究生:

這一趟赴希臘的生態工程研討會使我獲益良多,研討會有來自世界各地的學者,研究領域也都不盡相同,有很多在臺灣從未聽聞的研究方向,讓人十分驚訝,原來還能夠有這麼多的變化方式。參與這次研討會除了瞭解各國目前研究發展之外,我認為更加有意義的是能夠將這些方式、方法適用到臺灣,特別是其中有不少臺灣可能缺失的部分,比如旱季缺水、光電板效能、土壤恢復及減碳方式等研究。當然,除了研討會內容相當豐富之外,我們還體驗了希臘當地菜餚,這對我而言是非常難得的體驗。經過這次會議,我更加瞭解自己應該增進外文能力,才能夠順利與世界接軌。從這次研討會能看出世界各國應對氣候變遷的作為,也能看出大家都積極在對減碳轉型、保護環境做貢獻,希望臺灣在接下來的幾年也能成功完成淨零轉型,達到淨零碳排的目標。

# 七、參考文獻:

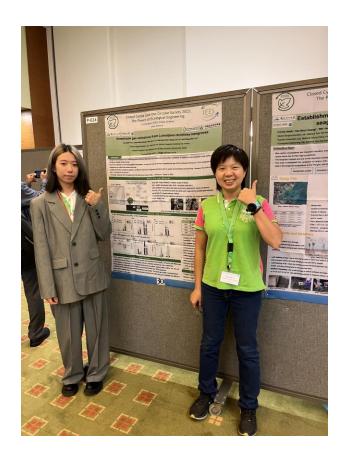
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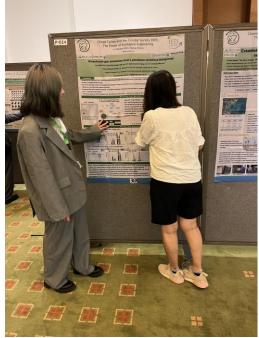


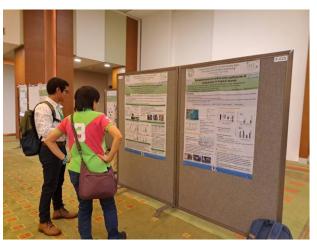
附件一

(a)









圖一、(a)海報合照;(b)與會者討論照片。





## IEES 2023 PROGRAM



Closed cycles and the Circular Society 2023 The power of ecological engineering 1-5 October 2023, Chania, Greece



 Sunday 1 Oct
 Grand Arsenal (Chania old port)

 17:30 - 18:00
 Registration

 18:00 - 20:00
 Welcome reception (+registration)

O = Oral presentation: 10 min talk + 4 min Q&A + 1 min buffer (Speaker change)

iday 2 Oct				ROOM 2
	08:00 - 09:00	Registration (lobby area)		
	PLENARY SESSION I	anakis & Andreas Schönborn		
	09:00 - 09:15	CONFERENCE OPENING AND WELCOME		
	09:15 - 09:30	Alexandros Stefanakis, IEES President WELCOME MESSAGES		
	09.13 - 09.30	Professor Michalis Zervakis (TUC Rector)		
		Ioannis Malandrakis (Mayor of Platanias) Panagiotis Simandirakis (Mayor of Chania)		
	09:30 - 10:15	KEYNOTE: Nature-based Solutions for Wastewater Treatment and		
		Application of Circular Economy strategies		
	10:15 - 10:45	Fabio Masi (Iridra Srl, Italy)  Coffe break (lobby area)		
		Session A1: Circularity in the built environment	Session A2: Social dimension of NBS	Session A3: Resource recovery from water
		Chair: Mateus Dina & Schubert Hendrik	Chair: Mark Dyer & Johannes Heeb	Chair: Francisco Erika Cristina + Gajewska Magdalena
	10:45 - 11:00	(O-099) A spatial perspective on circular economy and the construction sector within Flanders (Belgium)	(O-030) Methodological approach for assessing the effectiveness of co-creation processes of Nature-based solutions: The case-study application of CLEVER Cities project.	(O-119) Framework elaboration for the development of hybrid modelling for re recovery from municipal wastewater and impact mitigation in Gotland/SE
	11:00 - 11:15	Pisman Ann (Belgium) (O-021) Valorisation of the stabilized organic fraction of mixed municipal	Mahmoud Israa (Italy) (O-112) Why there are not more Nature-Based Solutions implemented in	Francisco Erika Cristina (Sweden) (O-040) Production and recovery of orthophosphate from phosphonate-contami
	11.00 11.13	waste as building materials within a circular economy	European cities: A Stakeholder Analysis	wastewater combining ozonation and ultraviolet advanced oxidation processes
		Santos Michael M. (Portugal)	Pineda-Martos Rocío (Spain)	Ji Yuxian (Belgium)
	11:15 - 11:30	(O-014) Formalising the temporal aspect of timber component reusability in a	(O-087) The use of Participatory System Dynamics Modelling to support 'Nexus	(O-044) Exploring the potential of cyanobacterial microbiomes for sustainable
		circular construction indicator Anastasiades Kostas (Belgium)	doing': preliminary results from the Koiliaris (Greece) case study Pagano Alessandro (Italy)	bioproducts Joan Garcia (Spain)
	11:30 - 11:45	(O-135) Waste to construction: A novel Hempcrete product research	(O-152) Multi-criteria tool for Nature-based Solutions and Bioeconomy practices selection towards WEFE Nexus implementation: the case of Tinos island	(O-048) Electrocoagulation flotation treatment technology in perspective of re- recovery and reuse of municipal wastewater in different regions of the world
			·	
	11:45 - 12:00	Meir Isaac (Israel) (O-162) Eco-traditional buildings in Makkah: Al-Byaddiah Palace as a case study	Tsatsou Alexandra (Greece) (O-009) Combining public participation, participatory design and AI to promote integrated planning approaches	Hassan Nazia (Belgium) (O-134) Sidestream sulphide-driven denitrification as robust solution to enable recovery in a large-scale industrial WWTP
	12:00 - 12:05	Faredah Almurahhem (Saudi Arabia)  (F-016) Plant-based biocides for the sustainable conservation of built heritage	Dyer Mark (New Zealand)	Polizzi Cecilia (Italy)
		Field experiments     Mateus Dina (Portugal)	(O-163) Tiganokinisi: social innovation though the collection and recycling of	(O-069) Recovery of resources and generation of valuable products from municipal control of the
	12:05 - 12:10	(F-034) Advancing circular economy in the built environment: The CircularB	domestic used cooking oil in Cyprus	wastewater – assessment of products quality
		Action Pineda-Martos Rocio (Spain)	Petsa Demetra (Cyprus)	Krzeminski Pawel (Norway)
	12:10 - 12:15	(F-057) Biomimicry in architectural design in a holistic design process Nowak Anna (Poland)		
	12:15 - 13:45	Nowak Anna (Poland)  Lunch time!		
		Session A4: Novel designs of Constructed Wetlands	Session A5: The impact of urban NBS on public health and well-being	Session A6: Circular design for increased resilience I
			Chair: Kolokotsa Dionysia & Mahmoud Israa	Chair: Filippos K. Zisopoulos & Goonetilleke Ashantha
	13:45 - 14:00	Chair: Uggetti Enrica & Jan Vymazal (O-104) The Integrated constructed wetland design approach: A review	Chair: Kolokotsa Dionysia & Mahmoud Israa (O-008) On the integration of nature-based solutions for health and wellbeing in	(O-083) Bioregional approach for circular design: case study in Roma via Guido
	1		two European Cities: The case studies of Dundalk and Skelleftea	(Italy)
		Harrington Rory (Ireland)	Kolokotsa Dionysia (Greece)	Francese Dora (Italy)
	14:00 - 14:15	(O-095) Efficiency removal of specific substances in multistage treatment wetland for urban drainage water	(O-110) Measuring the impact of Nature-Based Solutions on citizens' health and well-being: risks and challenges of using wearable devices	(O-096) Why edible cities?
		Gajewska Magdalena (Poland)	Biesaga Mikolaj (Poland)	Regelsberger Martin (Austria)
	14:15 - 14:30	(O-100) Removal performance of different types of bioelectrochemical constructed wetlands for dairy wastewater treatment	(O-088) Greenness visibility in urban living environments as pathway to promote health and well-being: mapping spatial differentiation in Flanders (Belgium)	(O-085) El Remanso experimental center in Choachí-Colombia, A laboratory Eco to learn and co-build
			based on viewshed analysis	
rledge Transfer Event	14:30 - 14:45	Kotsia Dimitra (Greece)  (O-171) Performance of pilot-scale constructed wetlands with different	Vervoort Peter (Belgium) (O-151) Urban greenery's effects on public health and wellbeing of citizens and	Rojas Hector (Mexico) (O-061) How circular design and integrated planning approaches may increase
(lobby area)		designs and substrates treating olive mill wastewater Dimitra Moschogianni (Greece)	how to assess it – preliminary euPOLIS findings Randelovic Ania (Serbia)	and biodiversity? Adam Avshalom M. (Israel)
SEALIVE	14:45 - 14:50	(F-052) Floating constructed wetlands based on recycled polymers to restore	And the second s	MITTER STATE
ies of Circular Economy		aquatic ecosystems López Daniela (Chile)		
Advanced bio-based ons to keep our Lands	14:50 - 14:55	(F-009) Selecting innovative substrates materials: characterization and	(O-155) Innovative urban solutions to enhance public spaces and promote good public health and wellbeing - the case studies of euPOLIS and VARCITIES	Advancing Sustainability of Process Industries through Digital and Circular Wate Innovations – Experience from AquaSPICE project
eas alIVE from plastic		potential application for enhancing CWs sustainability Ventura Delia (Italy)	Public health and wellbeing - the case studies of euPOLIS and VARCITIES  Randelovic Anja (Serbia)	Arampatzis Goerge (Greece)
contamination	14:55 - 15:00	(F-017) Smart monitoring of waste-filled constructed wetlands for the		
ISOTECH Ltd		removal of nutrients from wastewater with low carbon content Pinho Henrique (Portugal)		
1 Project & Research	15:00 - 16:00	Coffe break (lobby area) & Poster session		
		Session A7: Sludge management using NBS	Session A8: Sustainable Drainage Systems	Session A9: Circular water economy
Center			- ·	•
Center	16:00 - 16:15	Chair: Alexandros Stefanakis & López Daniela (O-032) A pilot study of domestic sewage sludge dewatering using Sludge	Chair: Frank van Dien & Tsatsou Alexandra (0-076) Blue-green infrastructure in highly urbanized areas - practical design	Chair: Simos Malamis & Tjasa Griessler Bulc
Center	16:00 - 16:15	Chair: Alexandros Stefanakis & López Daniela (0-032) A pilot study of domestic sewage sludge dewatering using Sludge Treatment Reed Beds in Oman	Chair: Frank van Dien & Tsatsou Alexandra (0-076) Blue-green infrastructure in highly urbanized areas - practical design examples	Chair: Simos Malamis & Tjasa Griessler Bulc (O-159) Water companies and circular economy: Challenges and opportunities
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Batrines Johannes Fabian (Germany)  (D-04) India proposes  Lar Verl (Talwan)  (Greece)  (D-06) Energy efficient bipolar membrane electrodetionization for integrated water and chemical recoveries from wastewater of recycled polyethylene terephthaliate processes  Lar Verl (Talwan)  (Cologo Urban ague & Broda Jan  (D-06) (D-06) Sullian ague & B	Chair Frank van Dien & Tsatsou Alexandra  (0-70) Buber green infrastructure in lighly urbanized areas - practical design examples  camples  (0-70) Buber green infrastructure in lighly urbanized areas - practical design examples  (0-10) Automated programment in temporary humanizarian settlements:  (0-10) Automated programment in temporary humanizarian settlements:  (1-10) Automated programment in temporary humanizarian settlements:  (1-14) Experimental autory and modelling of granular filter nedia used within SuDS for stormwater purification  (0-149) Experimental autory and modelling of granular filter nedia used within SuDS for stormwater purification  (0-129) Assessment of the potential for microplastic retention in mature SUDS  Calzadilla Cabrera Dario (Spalin)  ROOM 1  Session 82: Green roofs and walls  Chair Michael Ruby & Pineda-Martos Rooio  (0-146) If you build it, they will come: invertebrates on green roofs  Michael Ruby (Australia)  (0-128) Propolarion and present programment is setup for green roof filammability testing  case study in Medierraneous area  (0-158) News companisational tool for coupling water and heat transport models  - publishing on green roofs  20-159 (News Companisational tool for coupling water and heat transport models  - publishing on green roofs  (0-178) Performance of three ornamental species for indoor living walls irrigated with greywater  Perse-  Urestaras Lius (Spalin)	Chair: Simos Malamis & Tjass Griessler Bulc (C-159) Water companies and crudar economy: Challenges and opportunities standard Cristical (Greecia) (C-150) Water econey in swimming pools in accordance with the assumption concluse reconey studies Exist (Fedand) (C-151) Water recovery in swimming pools in accordance with the assumption concluse reconey studies Exist (Fedand) (C-151) Water recovery in swimming pools in accordance with the assumption concluse recovery studies Exist (Fedand) (C-151) Water recovery in swimming of recycled water using effect-based bioassay studies for existing the conclusion of the circular economy Schoeborn Andreas (Sicitratinal) (C-151) Water recovery in the conclusion of the recovery of the circular economy Various Tables (Switzerland)  Session B3: Sustainable management of waste biomass Chair Adl list (Vakan & Timo Steinbrecher (C-027) Deep eutectic solvent pre-treatment of residual biomass streams - effect anaerobic degradability Schultz Jason (Germany) (C-031) Transforming biogenic waste through anaerobic digestion in achieving cruciar economy (S-151) Childhos (Tabush) (C-039) Potential applications of hasehold industry waste based on material pre- Aguades Gonziller Lavar (Spilan) (F-020) Wood fromtatian sheep: maximizing resources utilisation Schoela Admender Kataryna (Poland) (F-003) Replication of sheep wool as slowly released organic fertilizer in tomato winter wheat cultivation (F-003) Replication of sheep wool as slowly released organic fertilizer in tomato winter wheat cultivation (F-003) Replication of sheep wool as slowly released organic fertilizer in tomato winter wheat cultivation (F-003) Replication of sheep wool as slowly released organic fertilizer in tomato winter wheat cultivation (F-004) Application of sheep wool as slowly released organic fertilizer in tomato winter wheat cultivation (F-005) Replication of sheep wool as slowly released organic fertilizer in tomato winter wheat cultivation
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	11:50 - 11:55	CO-203) Orden Dioeconomy. Inapping organic resource streams and the dio- symbioses in cities through Geospatial and Material Flow Analysis Yang Nan-Hua Nadja (United Kingdom)	(F-018) Coupling retired electric vehicle batteries with PV systems for urban sustainability: the case study of Greece	נט־10.3) וג וז a waste to waste waste. examples of circularity ווז אפווץa aliu maii נוטג listen to your grandfather) Ruud Kampf (Netherlands)
	11:55 - 12:00		Kastanaki Eleni (Greece) (F-021) Renewable resources in the conditions of the Slovak Republic	
	12:00 - 12:05	(F-038) Analysis of the aquaponics system sustainability via system dynamics modelling – FEW nexus approach	Daneshjo Nagib (Slovakia) (F-020) Effect of environmental factors on dust accumulation and the efficiency of photovoltaic panels: A study case in an Andean City	(F-003) Training a new generation of farmers and agricultural entrepreneurs to implement the concept of circular economy in agriculture – the TANGO-Circular
	12:05 - 12:10	Francisco Erika Cristina (Sweden)  (F-064) Analysis of selected factors determining the possibility of introduction and effective operation of rainwater sharing systems for hydroponics in existing multi-family buildings	Sanchez Nazly (Colombia)  (F-045) Forest conversion and GHG emission in screening and EIA procedures regarding PV sys-tems in Croatta	Erasmus plus project George P. Spyrou (Greece) (F-065) Towards sustainable food systems deploying Circularity Compass Strategy
	12:10 - 12:15	Bajk Joanna (Poland) (F-056) Close cycle approach in a food farm in Reggio Emilia, Italy	Kalcicek Matea (Croatia)  (F-048) Implementation of DSS to optimize the selection of marine energy sites on the Mexican coastline	Papadopoulou Kyriaki Maria (Greece)
	12:15- 12:20	Romagnolli Floriana (Italy) (F-022) Optimization of wheat nutrition for regenerative agriculture	Rivera Camacho Graciela (Mexico) (F-049) Osmotic power generation-based System for self-consumption electricity	(C-185) Advancing sustainability in industrial supply chains by embracing circular approaches and digital transformation Maria Aryblia
	12:20- 12:25	Sadovski Alexander (Bulgaria) (F-067) Development of a blockchain solution for food waste management	Ortiz Salcedo Monserrat Karina (Mexico)  [F-071] The SunAir Fountain panel: solar-powered drinking water production	(Greece)
	12:25 - 14:00	Plakas George (Greece) Lunch time!	from the air humidity Alexandros Stefanakis (Greece)	
	14:00 - 14:45	KEYNOTE: Nature-based solutions to optimize the Water-Ecosystem- Food Nexus at the basin scale		
		Nikolaos Nikolaidis (Technical University of Crete, Greece) Session B7: Stormwater management	Session B8: Constructed wetlands applications	Session B9: Ecological restoration
	14:45 - 15:00	Chair: Polizzi Cecilia & Henrique Joaquim de Oliveira Pinho  (O-057) Nature-Based Solutions for flooding risk mitigation in an urban area:	Chair: Giuseppe Cirelli & Ioannis Asimakoulas  (0-013) Assessing the treatment capacity of an ecological engineered wetland	Chair: Zhang Mingye & Schoeman Yolandi (O-051) The role of natural processes in post mining land reclamation
	14:45 - 15:00	The case study of Catania (Sicily, Italy)	(LO-U3) Assessing the treatment capacity of an ecological engineered wetand receiving AMD over a period of nine years using water quality and periphyton as indicators  Oberholster Paul Johan (South Africa)	[U-us1] The role or natural processes in post mining land reclamation  Frouz Jan (Czech Republic)
	15:00 - 15:15	Sciuto Liviana (Italy) (0-165) Adoption of ecohydrology approaches for urban stormwater management and advancing the circular economy concept	(O-172) Efficiency of pilot scale constructed wetlands with various substrates for landfill leachate treatment	(O-073) Phytocap soil density specification for optimum plant water use and root growth
	15:15 - 15:30	Goonetilleke Ashantha (Australia)  (O-019) Advancing Nature-Based Solutions for the management of water quality under the umbrella of the UNESCO IHP Ecohydrology Programme:	loannis Asimakoulas (Greece) (O-074) Use of Vertical Flow Constructed Wetlands for domestic laundry wastewater treatment with ornamental plants	Ruby Michael (Australia) (0-033) Organic amendments-based technosols for the restoration of Mediterranean habitats and soil-carbon sequestration
	15:30 - 15:45	case study of Pilica river catchment in Poland Jarosiewicz Paweł (Poland)  (O-101) Science behind STORMEE - STORMwater Environmental Efficiency	Stefanatou Aimilia (Greece) (O-043) Small constructed wetland in Norwegian agricultural catchment – 18	Carabassa Vicenc (Spain) (O-045) Ecological engineering enhances ecological restoration in Chinese desertified
		toolkit: 1) infiltration basin Vasilic Zeljko (Serbia)	years monitoring and perspectives for the future Krzeminska Dominika (Norway)	lands Xinrong Li (China)
	15:45 - 15:50	(F-019) Sub-calibration of soil moisture sensor for stormwater management	(F-037) Life cycle assessment of Horizontal Subsurface Flow Constructed Wetlands: The importance of regional characteristics to enhance environmental protection	(F-023) Significance of soil type and applied fertilization on the content and uptake of macroelements with sunflower biomass
	15:50 - 16:30	Perry Joseph (Finland) Coffe break (lobby area) & Poster session	Goulart Coelho Lineker Max (Denmark)	Petkova Zdravka (Bulgaria)
		Session B10: NBS for climate change adaptation	Session B11: Water quality improvement for resource efficiency	Session B12: Ecological engineering for the protection of land and biodiversity
	16:30 - 16:45	Chair: Nikolaos Nikolaidis & Dimitra Kotsia  (O-169) CARDIMED - Climate Adaptation and Resilience Demonstrated In the MEDiterranean region	Chair: Darja Istenič & Pawel Krzeminski (O-077) Degradation of organic micropollutants in a modified OECD 308 test: implications for the use of reactive amendments in nature-based systems	Chair: Carabassa Vicenc & Joan Garcia (0-164) Integrating the scope of ecological engineering applications: A structured framework with case studies from Australia
		Simos Malamis (Greece)	Perdana Mayang Christy (Czech Republic)	Dale Glenn (Australia)
	16:45 - 17:00	(O-050) Development of a climate change adaptation plan for the Jordan Valley based on WEFE nexus analysis: The EcoFuture project Nikolaos Nikolaidis (Greece)	(O-020) Degradation of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in secondary effluent by nonthermal plasma: role of reactive oxidative and reductive species  Chen Changtao (Belgium)	(O-160) Field application of processed biosolids: Integrating municipal waste management and regenerative agriculture in Canada
	17:00 - 17:15	Nikolaos Nikolaidis (Greece) (O-143) A gimpe into the euPOLIS multi-dimensional indicator system for site screening & NBS assessment  Baki Sotiria (Greece)	Chen Changtao (Belgium)  (0-19) Techno-Economic Feasibility Analysis (TEFA) of the Advanced Primary  Filtration (APF) process as a retrofit system at the municipal Wastewater  Treatment Plant (WWTP) of Marpissa, Paros, Greece	Grant Clark (Canada)  (Co-13) Innovative bioinspired intervention to control the growth of a new spit and reduce the occlusion of the mouth of the Goro lagoon (Italy)  Format Corinna (Italy)
	17:15 - 17:30	(O-154) The water reuse potential of nature-based solutions in response to the increased water scarcity risks imposed by climate change	(O-080) Quantifying the effects of grazing beef cattle on microbial quality of surface water	(O-029) Modification of spent coffee grounds for their use as organic fertilizer
	17:30 - 17:35	Apostolaki Stella (Greece) (F-031) Development of an Nb5 evaluation framework in the nexus of Sustainability, Circularity and Justice	Gilboa Ben-David Yael (Israel)  [F-041] Occurrence of ESKAPE pathogens in wash waters of the agri-food industry in view of the implementation of a closed loop economy	Juglova Zuzana (Czech Republic)  (F-010) Nature-based solutions using ecological engineering and dedicated to combine the mitigation of natural risks linked to water with benefits for biodiversity: considerin interdisciplinary and transdisciplinary approaches
	17:35 - 17:40	Mavrigiannaki Angeliki (Greece) (F-036) What do we know about the interactions between Nature-based solutions (NBS) and landscape?	Kanarek Piotr (Poland)  (F-053) Biological treatment of synthetic hypersaline wastewater: inoculum selection and start-up of a sequencing batch rector	Rey Freddy (France) (F-014) Short term results of different planting technologies applied in the restoration of European habitats
	17:40 - 17:45	Sowińska-Świerkosz Barbara (Poland)  (F-054) Integrating YamiTao traditional ecological knowledge into ecology education - an exemplification of Nature-Based Learning	Polizzi Cecilia (Italy)  (F-002) Innovative hybrid dairy wastewater system assisted by an intelligent software tool for quality prediction of the processed product water to be used	Carabassa Vicenc (Spain)  (F-042) Ecosystem services value dynamics under land use alterations in the upper Ganga riverine wetland
			for crop irrigation in a greenhouse	
	19:30	Lu Pei-Luen (Taiwan) Conference dinner @ Diogenis Restaurant	for crop irrigation in a greenhouse George P. Spyrou (Greece)	Kansal Mitthan Lal (India)
Wednesday 4 Oct	19:30	Conference dinner @ Diogenis Restaurant	for crop irrigation in a greenhouse	Cansal Mitthan Lal (India)
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15:00 - 15:15		(O-092) Native vegetation for the reuse of treated municipal wastewater:	
		Implications for greenhouse gas emissions	
		Meister Alexandra (New Zealand)	
15:15 - 15:20		(F-047) Over 80% water recovery from urban greywater using nanofilter	
		membranes – A Swedish case study	
		Hall Ashley (Sweden)	
15:20 - 15:25		(F-027) Integrating academic knowledge on "Sustainability of Agricultural Water	
		Management"	
		Dahal Bishal (Finland)	
15:20 - 16:00	Coffe break (lobby area)		
PLENARY SESSION IV			
Chair: Alexandros Stefa	nakis & Andreas Schönborn		
	KEYNOTE: Developing ecological engineering solutions: Low-tech should not		
	be low-knowledge		
	Ranka Junge (Zurich University of Applied Sciences, Switzerland)		
16:45 - 17:15	CLOSING SESSION & AWARDS		
	IEES2023		

		IEES2023
Thursday 5 Oct		Tours & Fieldtrips (separate info to be sent)
marsauy 5 oct		Tours & Headings (separate into to be sent)
LIST OF POSTER PRESENTATIO	NS	
NAME	COUNTRY	POSTER TITLE
Pástor Michal	Slovakia	[P-002] Survival rate of selected newly planted urban trees in the city of Nitra (Slovakia) in the context of circular economy
Bauer Johannes Fabain	Germany	(P-005) Reclamation of land from fluid hydrocarbon extraction: State of the art and current challenges
Sirakov Ivaylo	Bulgaria	(P-006) Influence of different exposure times of treatment with a microelement in an aquaponic system on hydrochemical indicators and productivity of pepper (Capsicum annuum) cultivated integrated with common carp (Cyprinus carpio)
Zou Yuanchun	China	(P-008) Wetland-based solution for sustainable water management in a semiarid irrigation area subject to water use conflict
Aleksandryan Anahit	Republic of Armenia	(P-009) Tailings management facilities: risk reduction
Yang Mingyue Lyu Xianguo	China China	[P-010] Efficient removal and electrochemical detection of heavy metals by utilizing heavy-metal-tolerant bacteria from sludge [P-011] Efficient removal and electrochemical detection of Docs and return of DOC in the weighted plants and present the sanising Plant, Northeast China [P-011] Efficient removal and electrochemical detection of DOC in the weighted plants and present the Sanising Plant, Northeast China [P-011] Efficient removal and electrochemical detection of DOC in the weighted plants and present the sanising Plant, Northeast China [P-011] Efficient removal and electrochemical detection of DOC in the weighted plants and
Da Costa Maria	Portugal	[P-014] Physics of sound and SDGs: Raising awareness for the dangers of noise pollution
Çam Miyase Deniz	Türkiye	[P-015] Deep eutectic solvent pretreatment of olive tree biomass
Janczukowicz Wojciech	Poland	(P-016) The effect of external carbon source type and dose on nitrogen and phosphorus removal in Sequencing Biofilm Batch Reactor (SBBR)
Rodziewicz Joanna	Poland	(P-017) The influence of the method of organic substrate dosing on the efficiency of Sequencing Biofilm Batch Reactor (SBBR)
Jang Jeonghwan	Republic of Korea	(P-0.19) Aerobic DNRA-performing neobacillus ys. strain isolated from rice paddy field soil, Republic of Korea (P-0.019) Significance of soil type and applied fertilization on the content and upstate of macroelements with surflower biomass in pot experiments
Petkova Zdravka Barati Bahram	Bulgaria Belgium	(P-0.2) Enhance to soft yee and appropried returnation or the content and uphase or made determined with a summover tolorists at port experiments  (P-0.2) Enhance to soft yee and appropried returnation or the content and uphase or made determined with a summover tolorists at port experiments  (P-0.2) Enhance to soft yee and appropried returnation or the content and uphase or made determined with a summover tolorists at port experiments  (P-0.2) Enhance to soft yee and appropried returnation or the content and uphase or made determined with a summover tolorists.
Mielcarek Artur	Poland	( PO21) Binnering - Supporting dentification and dephosphatical with citric acid
Borodinecs Anatolijs	Latvia	[P-022] Dynamic electricity price: challenge for selection of cost-optimal PV Systems for households
Aljabri Khalid	Oman	[P-023] Remote sensing analysis for vegetation assessment of a large-scale constructed wetland treating produced water polluted with Oil hydrocarbons
Lin Chiao-Wen	Taiwan	[P-024] Greenhouse gas emissions from Lumnitzera racemosa mangroves
Lin Chiao-Wen	Taiwan	[P-025] Stablishment of carbon sink coefficients of seagrasses in tropical islands [P-026] Biosethano production from microwave-assisted deep euterities objected new production from the production from the production from microwave-assisted deep euterities objected new production from the production from
Isci Asli Aslanhan Dicle Delal	Turkey Türkiye	(IP-UZ) Bioethanol production from microwave-assisted deep eutectic solvent pretreated wheat straw (P-UZ) Bioethanol production from microwave-assisted deep eutectic solvent pretreated wheat straw (P-UZ) Bioethanol productic solvent pretreatment of oil pick pomace (P-UZ) Bioethanol productic solvent pretreatment of oil pick pomace
Asiannan Dicie Delai Kováts Nora	Hungary	(P-029) Can landraces better cope with environmental stress?
Schubert Hendrik	Germany	(F030) Nature-based coastal protection measures in a directal society
Nabelek Jakub	Czech Republic	(P-031) Effect of wheat bran pre-treatment on isolation of ferulic acid
Steinbrecher Timo	Germany	[P-032] Production of biogenic aromatics from lignocellulosic agricultural residues
Sarabi Shahryar	Netherlands	[P-033] Promoting environmental justice in urban transitions: an embedded view [P-034] Mannyov carbon budgets suerest the estimation of net production and carbon burial by quantifying litterfall
Lin Wei-Jen Ghosh Savanti	Taiwan India	(P-033) Mangrove caron dougets suggest the estimation of net production and caron on any quantitying internal (P-035) Bioches supported Agriculta (P-034) Bioches supported (P-034) Bioches supporte
Truu Jaak	Estonia	(P-035) British supervening may a great catalyst not beginning and priminaceurus primi
Kimura Keiichi	Japan	[P-037] Cyanobacterial biocrust development on biomineralized sandy soil: new dryland restoration method
Tejada Manuel	Spain	[P-038] Green pepper (Capsicum annuum) fruit quality. Effects of the application of biostimulants obtained from slaughterhouse sludge
Tejada Manuel	Spain	(P-039) Application of a biostimulant obtained by enzymatic hydrolysis from slaughterhouse sludge in the bioremediation of soils polluted by the imazamox herbicide
Montero Pau	Spain	[P-043] Drone monitoring of extractive activities in Catalonia: a collaborative system for improving the sustainable management of the mining sector [P-042] Design of a themical/biological bibnasis crocess for circular economy for the conversion of polymerishane into aeronomic biostimulants
Parrado Juan	Spain	(P-0.42) Effect of sewage studge enon- and co-figestion on nutrients removal from reject water
Kulbat Eliza Parrado Rubio Juan	Poland Spain	(P-043) Entect of sewages adopt monor and congression of multi-interfect water  [P-044] Bioprocess of Keratin wastes conversion into aeronomic biostimulants and biofertilizer
Wilinska-Lisowska Anna	Poland	(P-045) Possibilities of nutrients recovery from the liquid fraction of digestate from agricultural biogas plants in Poland
Montero Pau	Spain	(P-046) Remote sensing indicators for the study of drylands in Mediterranean climate
Ponis Stavros	Greece	(P-047) Be Well and Green When Digital - Lessons Learnt from the BeWEEN project
Truu Marika	Estonia	(P-048) Enhancing methane mitigation in landfills: insights from biocover composition and microbial parameters
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