SUSTAIN

Sustainable use of salt-affected lands

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EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

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BOOK OF ABSTRACTS

3rd Annual Meeting of the SUSTAIN Project (CA22144)

Polytechnic Institute of Viseu, Portugal

18–19 May 2026

Editors

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PROGRAMME

18 May 2026 – Day 1

8:30 – 9:00	Registration and posting of posters	
9:00 – 9:30	Ice-breaker and getting to know each other	
9:30 – 10:00	Opening session	
10:00 – 10:30	Coffee break	
10:30 – 12:30	**WG1 session (Aula Magna) –** **Chair: Iraklis Pavlou** **10:30** Introducing new leadership of WG1 (Iraklis, Hesam, Muhammad) **10:40** Keynote lecture: *Salty Water, Salty Soil, and Stubborn Wheat: When Yield Refuses to Give Up* – Hesam Mousavi **11:10** Oral presentation: *Evaluating the Role of Salinity in the Desertification Process Using an AHP-Based Decision Support Model: The Case of Central Anatolia Region of Türkiye* – Turgay Dindaroglu **11:25** Oral presentation: *Assessment of Post-Drainage Impacts on Groundwater Depth and Salinity Dynamics in the Harran Plain* – Ali Volkan Bilgili **11:40** Interactive session: D1.4.2 White paper providing guidance on soil mapping to capture heterogeneity, sustainable agricultural practices and identifying gaps and new innovations/technologies; D1.2.1 Identification of the relevant spatio-temporal time scales when monitoring soil salinity **12:20** Wrap up and next steps	**WG2 session 1 (Auditório)** **Cross-disciplinary knowledge creation and capacity building across WGs (Task 2.8) —** **Chair: Agnieszka Piernik** **10:30** Agnieszka Piernik et al. — *Sustainable Use of Salt-Affected Lands: A Cross-Disciplinary Synthesis* **11:00** Jagoda Szydło, Bliss Ursula Furtado, Katarzyna Hrynkiewicz — *Genomic insights into plant growth-promoting bacterial endophytes and their role in Poaceae under salt stress* **11:15** Discussion — *Bridging Disciplines to Solve Salinity: Pathways to Sustainable Land Use — PBS approach* **Use of data collected in SUSTAIN, SUSTAIN databases and re-use them in the after-SUSTAIN time (Task 2.7) —** **Chair: Jutta Papenbrock** **11:30** Giulia Atzori — *Salt-tolerant neglected and underutilized species: effects of salinity on their growth and quality* **11:50** Andre Fussy & Jutta Papenbrock, Sascha Offermann — *Introduction of the eHALOPH and the SUSTAIN databases — Can we apply AI for utilizing the data in a meaningful way?* **12:10** Jutta Papenbrock and panel — *Database standards and re-use databases after the SUSTAIN time*
12:30 – 14:00	Lunch	

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<tr><td>14:00 – 16:00</td><td>WG3 session (Aula Magna) – From best practices to economic value in salt-affected lands –
Chair: Zenepe Dafku
14:00 Welcome & WG3 Status Update
14:10 Best Practices from WG3 Members — Presentations (max 4 mins each)
14:15 Oral presentation: Use of salt-tolerant Atriplex species in arid and semi-arid regions in Türkiye – Cengiz Yücedağ, Nuray Çiçek, Ebru Gül
14:30 Interactive Session (WG3 members and members of other WGs)
15:30 Structuring the Booklet
15:50 Wrap-up & Next Steps</td><td>WG2 session 2 (Auditório)
Soil chemical and biological functions under salinity heterogeneous conditions (Task 2.4) —
Chair: Ian Dodd
14:00 Ian Dodd — Wishes for collaboration with WG1
14:15 Alessandro Esposito et al. — Salt Stress Tolerance in Cultivated and Wild Lettuce: Genotype
14:30 Irene Christophoridi et al. — Harnessing Native Mediterranean Plants for Climate-Resilient Diets, Ecosystem Restoration, and Saline Soil Sustainability
14:45 José A. Hernández et al. — Sustainable Intercropping of Arthrocaulon macrostachyum and Table Grape (Vitis vinifera L.) to Enhance Production in Salinity-Affected Soils
New breeding targets (Task 2.3) — Chair: Katarzyna Hrynkiewicz
15:00 Katarzyna Hrynkiewicz et al. - Microbiome phenotyping for evaluating salinity-adapted intercropping systems in a Mediterranean table grape orchard (Murcia, Spain)
15:15 Andre Fussy — From species identity to nutritional potential: Taxonomic and biochemical characterization of European halophyte crops
15:30 Katja Witzel — Picturing Natural Variation in Arabidopsis Root Architecture in Response to Salinity by Merging Growth Parameters and Genomic Information
15:45 Discussion — Interactive session</td></tr>
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Chair: Eleftheria Dalmaris
• Soil reclamation under organic management in a Mediterranean saline–sodic polder: effects of gypsum–sulphur–manure amendments and tillage — Igor Bogunovic, Kristina Kljak, Ivica Kisic [WG1]
• Drought amplifies estuarine salinity through reduced freshwater discharge — Jaqueline Q. Ferreira, Maiyai Hocheimy, László Kocsis, César Ordóñez, Momodou Faal, Amuzo Nkamnebe, Torsten Vennemann, Daniel F. McGinnis [WG1]
• Soil Salinity in Albania — Suela Spahiu [WG1]
• Filtering endophytic microbiomes from the rhizosphere environment by endemic Limonium plants — Dominika Thiem, Nadia Bazihizina, Kristine Petrosyan, Antonella Castagna, Bliss Furtado, Katarzyna Hrynkiewicz [WG1]
• Salinity in the Desertification Process Using an AHP-Based Decision Support Model: Sub-Watershed Scale — Turgay Dindaroglu [WG1]
• Anatomical Adaptations in Halophytes under heterogeneous conditions of saline soils — Marius-Nicusor Grigore, Ana Cojocariu [WG1]
• Planetary Resilience by Design — Emre Aksoy [WG2]
• Investigating salinity tolerance in Strombocarpa strombulifera: A molecular perspective on a mucilage-producing halophyte — Pascal Mende [WG2]
• Drought-induced metabolic shift, flavonoid biosynthesis, and chalcone synthase upregulation underpin cultivar-specific drought stress resilience in Lotus corniculatus — Yaqoob Sultan [WG2]
• Picturing Natural Variation in Arabidopsis Root Architecture in Response to Salinity by Merging</td></tr>
</table>

	Growth Parameters and Genomic Information — Susann Lindemeyer, Katja Witzel **[WG2]** • *Coordinated NHX-mediated ion sequestration and antioxidant responses drive short- and long-term salinity tolerance in quinoa* — Emre Aksoy **[WG2]** • *Salt-induced responses in the grain type of Amaranthus spp.* — Veronika Mistríková, Monika Szabóová, Andrea Hricová **[WG2]** • *Genomic insights into plant growth-promoting bacterial endophytes and their role in Poaceae under salt stress* — Jagoda Szydło, Bliss Ursula Furtado, Katarzyna Hrynkiewicz **[WG2]** • *Monitoring and Management of Soil and Coastal Salinization* — Amra Bratovcic **[WG3]** • *Harnessing Plant Growth-Promoting Bacteria to Increase Tomato Resilience to Salinity in Soilless Greenhouse Systems* — Sofia Isabel Almeida Pereira **[WG3]** • *From marginal to multifunctional: valorizing salt-affected lands through multifunctional ecosystem services* — Pablo Carril, Nadia Bazihizina **[WG3]** • *Assessing Ecosystem Service Functions of Some Halophytes in Türkiye* — Ebru Gül, Nuray Çiçek, Cengiz Yücedağ **[WG3]** • *Effective Use of Organic Fertilizers in the Biological Remediation of Saline Soils in Türkiye* — Nuray Çiçek, Ebru Gül, Cengiz Yücedağ **[WG3]** • *Sensory tests and outreach activities as tools for increasing consumer acceptance: insights from the xtremegourmet 2.0 project* — Marta Silva, Marta Oliveira, Inês Machado, Luísa Lisboa, Maria Palma Mateus, Miguel Salazar, Pedro Girão, Isabel M.P.L.V.O. Ferreira, Luísa Barreira **[WG4]** • *Transgenic Approaches for Enhanced Salt Stress Tolerance in Perennial Crops* — Muhammad Tahir Khan **[WG5]** • *An Assessment of Some Ecosystem Services in Soils Affected by Secondary Salinization in the Harran Plain* — Miraç Kiliç, Fatma Akbay Kiliç **[WG5]** • *Turning Challenges into Opportunities: Using Salt-Tolerant Triticale to Support Agricultural Policies for Saline Lands* — Signem Oney-Birol **[WG5]** • *Developing a Multi-level Stakeholder Database for Salt-Affected Land Management: Insights from the SUSTAIN COST Action* — Selim Bayraktar **[WG5]** • *Remote sensing approach for identifying and mapping saline soils in the national park of Khnifiss in the southwestern of Morocco* — Sarkouh Najat, Elblrhiti Hicham, Chahho Driss, Badidi Brahim **[WG6]**
19:00	Dinner in Viseu

19 May 2026 – Day 2

9:00 – 11:00	**WG4 and WG5 session (Aula Magna) –** **Chair: Ozkan Elmaz** **9:00** Keynote lecture: *Gene Editing Meets Soil Restoration: Will EU New Genomic Technique 1 (NGT1) Legislation Change the Future of Salt-Affected Soils?* – Henrik Aronsson **9:30** Keynote lecture: *The phenomenon of salinisation and European policies: Discussion and suggestions* – Vítor João Pereira Domingues Martinho **10:05** Oral presentation: *Assessing Entrepreneurship Potential in Salt-Affected Agricultural Lands: A SWOT Analysis Based Study* – Yaşar Selman Gültekin, Pınar Gültekin **10:20** Oral presentation: *Human Security and Ethical Aspects in the Policy Framework Development for a Better Salinisation Management* – Serghei Sprincean **10:40** Oral presentation: *Mapping Soil Salinity Hotspots and Recovery Zones in Türkiye: A National-Scale Sentinel-2 Trend Analysis* – Mehmet Ali Çullu
11:30 – 12:30	**WG4 and WG5 session (Aula Magna) –** **Chair: Henrik Aronsson and Vítor João Pereira Domingues Martinho** Interactive section addressing the Action tasks.
12:30 – 13:30	Lunch

13:30 – 15:00	**WG6 session (Aula Magna) –** **Chair: Catarina Gomes** **13:00** Keynote lecture: *SUSTAIN communication updates and introducing the e-platform for knowledge creation* – Muhammad Tahir Khan **13:20** Oral presentation: *Sustain Webinars and other dissemination activities* – Irene Christoforidi **13:40** Interactive session: Creation of SUSTAIN teaching material moderated by Catarina Gomes & Eleftheria Dalmaris **14:40** Wrap up and next steps
15:30 – 17:00	**Round table with stakeholders / local authorities / extension agents (Aula Magna) –** **Chair: Katarzyna Negacz** • **Confederação dos Agricultores de Portugal (CAP):** Luís Mira • **Confederação Nacional das Cooperativas Agrícolas e do Crédito Agrícola de Portugal (CONFAGRI):** Idalino Leão • **Quercus:** Paula Nunes da Silva • **Associação de Beneficiários do Plano de Rega do Sotavento do Algarve (ABPRSA):** José Macário Correia • **IrRADIARE:** Flávia Duarte • **Salina Greens:** Márcia Vaz Pinto • **CONSULAI:** Dina Lopes
17:00 – 18:00	MC meeting

Last updated on 11 May 2026

FOREWORD

Katarzyna Negacz, Nadia Bazihizina and Vítor João Pereira Domingues Martinho

Salinity is increasingly prominent on policy agendas worldwide. In the context of accelerating climate change and growing concerns about food security and biodiversity loss, preventing further soil and water salinization has become a critical component of managing multiple, interconnected crises. Salinization, the accumulation of water-soluble salts in soils, is one of the leading causes of land degradation, affecting approximately 833 million hectares of land and 1.5 billion people globally.

Despite its challenges, salt-affected land can be productively managed through saline agriculture, which integrates soil, water, and salt-tolerant crop management strategies. The sustainable cultivation of saline soils offers an important pathway to enhance food and water security under conditions of climate change, population growth, and increasing pressure on natural resources. Consequently, there is an urgent need to strengthen networks that link research, policy, and practice, and to promote the sustainable use of salt-affected lands.

The SUSTAIN COST Action meeting brings together scientists and practitioners from around 50 countries to address these challenges collaboratively. The meeting focuses on emerging and priority topics, including:

- Best practices in saline agriculture
- Cross-disciplinary knowledge creation and capacity building
- Drainage impacts on salinity and groundwater
- Economic value of salt-affected lands
- Modelling desertification and salinity dynamics
- New breeding targets for salt tolerance
- Salinization in European policies
- Soil chemical and biological functions under heterogeneous salinity conditions
- Stakeholder empowerment
- Performance of salt-tolerant crops and halophytes

Through presentations, posters, and interactive discussions, these themes lay the foundation for an international research and practice agenda on salinization. This gathering will serve as a key platform for networking, knowledge exchange, and the advancement of research, technology, and policy solutions to support the sustainable use of salt-affected lands.

ABSTRACTS

KEYNOTE LECTURES

WG1 – Soil and water salinity: physical and biochemical characteristics at different scales

Chair: *Iraklis Pavlou*

Salty Water, Salty Soil, and Stubborn Wheat: When Yield Refuses to Give Up

[WG1] *Keynote Lecture*

Hesam Mousavi

University of Inland Norway

Twenty-three lines from a mutagenized Bangladeshi BARI Gom-25 wheat population that included previously identified salt-tolerant lines, and the BARI Gom-25 control variety, were cultivated in a drip-irrigated salinity test field at Salt Farm Texel, Netherlands, to assess their performance during salt stress in European climatic conditions. Lines were tested at irrigation salinity levels of 1, 4, 8, 12, 16, and 20 dS m^{-1} in four repetitions of plots with 24 plants per plot. Average plant height, tiller number, spike length, frequency of live plants, and total grain weight (TGW) were recorded as functions of seasonal mean pore water salinity in the soil. Increases in salinity triggered reductions in all evaluated variables of the assessed lines and the control variety. However, nine mutagenized lines had at least twofold higher mean TGW than the control variety, 18.73 ± 4.19 g/plot at 1–16 dS m^{-1} salinity levels. Common models of salt tolerance confirmed this pattern, but there were no clear differences in salinity tolerance parameter estimates between the mutagenized lines and the control variety. Thus, despite the apparent similarity in responses of all lines to salinity increase, we clearly identified lines that tended to have higher TGW at given salinities than the control variety. This higher TGW at the full range of salinity treatments indicates not only a possible higher salinity tolerance but a higher yield potential as well. The mechanisms involved clearly warrant further attention.

Keywords: EMS; drip irrigation; mutagenized; salinity; salt stress; wheat; sustainable agriculture

WG4 – Knowledge sharing and stakeholders' engagement

Chair: *Ozkan Elmaz*

Gene Editing Meets Soil Restoration: Will EU New Genomic Technique 1 (NGT1) Legislation Change the Future of Salt-Affected Soils?

[WG4] *Keynote Lecture*

Henrik Aronsson

University of Gothenburg

Salt-affected soils threaten agricultural productivity across large areas of the world. Europe is also affected although to a lesser extent. New gene editing tools, especially CRISPR-based approaches, offer new opportunities to enhance crop tolerance to salinity by targeting e.g. stress-response pathways and ion transport mechanisms, and root system architecture. The new proposed

regulatory framework for New Genomic Techniques (NGT1) by EU aims to differentiate certain gene-edited crops from conventional GMOs, potentially accelerating their development and commercial use.

This presentation explores whether NGT1 legislation could act as a catalyst for integrating gene-edited crops into soil restoration strategies i.e. to bring back productivity on sol-affected lands. It examines the potential of salt-tolerant NGT1 varieties alongside regulatory, environmental, and socio-economic considerations. While gene editing alone cannot restore degraded soils, it will complement existing practices such as improved irrigation management and soil amendments.

The proposed legislation will be considered in terms of what is permitted and restricted. Practical aspects of implementing NGT1 will be highlighted, with emphasis on cereals, outlining the steps required to progress from initial concept, through laboratory workflows, to a confirmed NGT1 plant. The success of NGT1 in addressing salt-affected soils will depend on its integration into broader land management frameworks rather than as a standalone solution. Emerging NGT1 innovation pipelines have the potential to improve crop resilience to salt-affected soils, supporting food security.

Keywords: EU, gene editing, NGT1, practical aspects, salt-affected soils, cereals

WG5 – Policy framework for the salinisation management

Chair: *Ozkan Elmaz*

The phenomenon of salinisation and European policies: Discussion and suggestions

[WG5] *Keynote Lecture*

Vítor João Pereira Domingues Martinho

School of Agriculture (ESAV), Polytechnic Institute of Viseu (IPV), 3500-631 Viseu, Portugal Centre for Environmental and Marine Studies (CESAM), University of Aveiro, 3810-193 Aveiro, Portugal

Soil salinisation is an emerging and critical problem, with implications for the dynamics of farms in the most affected areas. It is urgent that policymakers place this issue on the agenda more effectively so that policy instruments capable of mitigating the associated causes and impacts can be defined. In this context, the aim of this research is to stimulate further discussion on soil salinisation processes in the European Union, thereby helping to raise the prominence of the issue and providing further insights that can support policymakers. To this end, a benchmarking analysis of the European Union's regulatory, strategic and policy framework is carried out. The results show that it is possible to improve the way in which soil salinisation issues have been addressed in the European Union.

Keywords: Legislation; Strategies; Benchmarking

Acknowledgements: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No CA22144 (COST Action CA22144 - Sustainable use of salt-affected lands (SUSTAIN)), as supported by the COST Association (European Cooperation in Science and Technology). This work was funded by national funds through FCT – Fundação para a Ciência e a Tecnologia I.P., under the project CESAM-Centro de Estudos do Ambiente e do Mar, references UID/50017/2025 (doi.org/10.54499/UID/50017/2025) and LA/P/0094/2020 (doi.org/10.54499/LA/P/0094/2020).

ORAL PRESENTATIONS

WG1 – Soil and water salinity: physical and biochemical characteristics at different scales

Chair: *Iraklis Pavlou*

Evaluating the Role of Salinity in the Desertification Process Using an AHP-Based Decision Support Model: The Case of Central Anatolia Region of Türkiye

[WG1] *Oral Presentation*

Turgay Dindaroglu

Karadeniz Technical University

Global climate change is leading to disruptions in hydrological balance, increased soil salinity, and consequently, accelerated desertification processes, particularly in semi-arid and arid regions. In Turkey, the Central Anatolian Region is among the areas susceptible to salinity-induced desertification due to low rainfall, high evaporation rates, declining groundwater levels, and intensive irrigation-based agricultural practices. The main objective of this study is to develop a holistic decision support model based on the Analytical Hierarchy Process (AHP) to monitor and evaluate the impact of salinity on the desertification process.

In this study, physical, chemical, biological, and hydroclimatic factors affecting desertification were evaluated hierarchically within the framework of the AHP approach. Basic salinity indicators such as soil electrical conductivity (EC), exchangeable sodium percentage (ESP), and sodium adsorption ratio (SAR) were considered as the main determinants of the model. Pairwise comparisons based on expert opinions were performed using Super Decisions software, and the consistency rates were determined to be at acceptable levels. The model was structured to reveal the direct and indirect effects of salinity on desertification susceptibility.

The results indicate that chemical soil properties play a decisive role in the desertification process in Central Anatolia. Soil salinization is both a trigger and an accelerator of the desertification process in 20% of the region. Increasing salinity leads to weakening of vegetation, decrease in biomass production, and increased erosion susceptibility. Temperature increases and irregular rainfall associated with climate change increase the risk of secondary desertification, especially in closed basins.

In conclusion, this AHP-based approach offers an effective decision support tool for monitoring salinity-induced desertification and prioritizing sensitive areas. Improving irrigation water quality, strengthening drainage systems, using salt-tolerant plant species, and climate change-adaptive land planning stand out as priority strategies for sustainable land management.

Keywords: Desertification, Soil Salinity, Analytical Hierarchy Process (AHP), Land Degradation, Sustainable Land Management

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Assessment of Post-Drainage Impacts on Groundwater Depth and Salinity Dynamics in the Harran Plain

[WG1] *Oral Presentation*

Ali Volkan Bilgili

Harran University

Ali Volkan Bilgili, Fatma Kaplan, Mehmet Ali Çullu

Introduction

Intensive irrigation in semi-arid regions can lead to groundwater rise and salinization, creating long-term environmental challenges. The Harran Plain, irrigated since 1995 under the Southeastern Anatolia Project (GAP), has experienced such impacts (Kendirli et al., 2005; Çullu et al., 2010; Bilgili et al., 2018). This study evaluates post-drainage changes in soil salinity, groundwater depth, and groundwater quality.

Methods

The study was conducted in the Harran Plain, Türkiye. Groundwater and soil data collected before drainage (2006–2009) and after drainage (2015–2024) were analyzed. Approximately 300 observation wells and soil samples were used to measure groundwater level and electrical conductivity (EC). Spatial and temporal analyses were performed using geostatistics and multivariate statistics (correlation, PCA, and clustering).

Results

Groundwater levels deepened by approximately 80 cm (116 cm in 2006 to 197 cm in 2024). Groundwater EC decreased from 2942 (2016 peak) to 877 µS/cm (2024), while soil EC declined from 4.34 to 2.48 dS/m. Despite overall improvement, strong spatial variability persisted across the plain.

Conclusions

Drainage implementation significantly improved hydrological conditions and reduced salinity; however, heterogeneous spatial patterns indicate that site-specific water and soil management strategies are still required for sustainable agricultural development.

Keywords: Harran Plain; drainage system; groundwater level; soil salinity; groundwater salinity; geostatistics; spatial variability; Southeastern Anatolia Project (GAP)

Acknowledgements: The authors would like to acknowledge the Harran University Scientific Research Projects Coordination Unit (HUBAP), the Scientific and Technological Research Council of Türkiye (TÜBİTAK), and the General Directorate of State Hydraulic Works (DSI) for their financial and institutional support throughout this study.

References:

Bilgili AV, Yeşilnacar I, Akihiko K, Nagano T, Aydemir A, Hızlı HS, Bilgili A (2018) Post-irrigation degradation of land and environmental resources in the Harran plain, southeastern Türkiye. Environ Monit Assess 190:660

Çullu, M. A., Aydemir, S., Qadir, M., Almaca, A., Öztürkmen, A. R., Bilgiç, A., & Ağca, N. (2010). Implication of groundwater fluctuation on the seasonal salt dynamic in the Harran plain, south-eastern Türkiye. Irrigation and Drainage, 59, 465–476.

Kendirli, B., Cakmak, B., & Ucar, Y. (2005). Salinity in the Southeastern Anatolia Project (GAP), Türkiye: issues and options. Irrigation and Drainage, 54,115–122.

WG2 – Plant responses to salinity at the shoot and the root level

Chair: *Agnieszka Piernik, Jutta Papenbrock, Ian Dodd, Katarzyna Hrynkiewicz*

Sustainable Use of Salt-Affected Lands: A Cross-Disciplinary Synthesis

[WG2] *Oral Presentation*

Agnieszka Piernik1, Ahmad Rajabi Dehnavi1, Piotr Hulisz2, Zenepe Dafku3,Jutta Papenbrock4

1Department of Geobotany, Faculty of Biological and Veterinary Sciences, Nicolaus Copernicus University in Toruń, ul. Lwowska 1, 87-100 Toruń, Poland 2 Department of Soil Science and Landscape Ecology, Faculty of Earth Sciences and Spatial Management, Nicolaus Copernicus University in Toruń, Lwowska 1, 87-100 Toruń, Poland 3Agricultural University of Tirana, Tirana, Albania 4Institute of Botany, Leibniz Universität Hannover, Herrenhäuser Straße 2, D-30419 Hannover, Germany

Soil salinization is an increasing threat to global agricultural productivity, particularly in arid, semi-arid, and coastal regions. Emerging perspectives recognize salinity not only as a constraint but as

an environmental condition requiring adaptive, system-based solutions. This review presents a cross-disciplinary synthesis of salt-adapted plant resources and saline agriculture, integrating crop diversity, breeding innovations, agronomic practices, and ecosystem assessment approaches. We highlight natural saline habitats and crop species already cultivated under saline conditions, including tolerant cereals (barley, sorghum, millets), industrial crops (cotton), oilseeds (rapeseed, sunflower), and root crops (sugar beet), alongside salt-tolerant cultivars of major staples such as wheat, rice, and maize. Advances in breeding are reviewed, encompassing conventional selection, marker-assisted approaches, QTL mapping, genome-wide association studies, genomic selection, introgression from wild relatives, mutation breeding, transgenics, and genome editing. The role of alternative glycophytes and halophytes is emphasized, with species such as camelina, safflower, quinoa, Atriplex, and Salicornia offering multifunctional benefits for food, feed, bioenergy, and ecological restoration. Their integration is supported by improved salinity management practices. Finally, the importance of standardized indicators and integrated datasets for assessing salt-affected lands and ecosystem services is highlighted, supporting knowledge integration within COST Action CA22144.

Keywords: saline habitats, saline agriculture; salt tolerance; halophytes; crop breeding; soil salinity

Genomic insights into plant growth-promoting bacterial endophytes and their role in Poaceae under salt stress

[WG2] *Oral Presentation*

Jagoda Szydło, Bliss Ursula Furtado, Katarzyna Hrynkiewicz

Department of Microbiology, Faculty of Biological and Veterinary Sciences, Nicolaus Copernicus University (NCU), ul. Lwowska 1, 87-100 Toruń, Poland

Endophytic bacteria represent a promising strategy for sustainable crop production in salt-affected soils. This study investigates how genomic features of bacterial endophytes contribute to plant growth promotion under salt stress.

The genomes of Labedella endophytica FR-P-L-64 and Pseudomonas stutzeri ISE-12 were characterized for plant growth-promoting and stress resistance improving genes. The effects of bacterial inoculation were evaluated under different salt concentrations using four Poaceae varieties.

Genome analysis revealed genes involved in indole-3-acetic acid (IAA) production, phosphate solubilization, siderophore synthesis, and gamma-aminobutyric acid (GABA) production. Genes related to nitrogen metabolism and spermidine biosynthesis were identified in P. stutzeri ISE-12, while ACC deaminase activity and glycine betaine production were characteristic for L. endophytica FR-P-L-64. Bacterial inoculation increased root length of two Lolium perenne varieties at 150 mM and 300 mM NaCl, but their shoot length was improved only in 150 mM. Bacterial endophytes enhanced shoot and root length of two Triticum aestivum varieties under 300 mM NaCl.

These findings indicate that bacterial genomic features does not directly translate into plant growth promotion and the response to bacterial inoculation depends on plant genotype and salinity level.

Keywords: salt stress, endophytic bacteria, genome analysis, Poaceae

Acknowledgements: Funding: Biodiversa+ European Biodiversity initiative (BiodivNBS) and the National Science Centre (NCN, Poland) (UMO-2024/06/Y/NZ9/00139) SaltyBEATS project

Salt-tolerant neglected and underutilized species: effects of salinity on their growth and quality

[WG2] *Oral Presentation*

Giulia Atzori

Italy

Despite the ongoing exponential population increase and the decrease of the availability of agricultural land, the challenge is to understand how to expand agriculture production without further constraining natural resources. As humans, we have historically used a vast number of plant species, with estimates suggesting 40000 species, while at present, 30 species produce 95% of human calories and proteins consumption. Is it not realistic to expect to feed a population rising to more than 9 billion people from a base of 30 crop species and Neglected and Underutilized Species (NUS), defined as species with underexploited potential for contributing to food security, nutrition, health, income generation, and environmental services, can increase crop production under not optimal environmental conditions. NUS are now receiving attention due to their high nutritive value and environmental stress tolerance can contribute to diet diversification creating more resilient and sustainable food production systems. Of the over 5000 species of neglected and underutilized salt tolerant halophytes identified to date many are edible and show crop potential in a saline agriculture context. This presentation will outline examples of how saline conditions translate into i) growth and productivity under saline conditions; ii) the nutritional characterization of the edible portions of salt tolerant species; iii) phytodesalinating potential of salt tolerant species.

Keywords: neglected and underutilized species; saline agriculture; food security

Introduction of the eHALOPH and the SUSTAIN databases — Can we apply AI for utilizing the data in a meaningful way?

[WG2] *Oral Presentation*

Jutta Papenbrock, Andre Fussy, Sascha Offermann

Institute of Botany, Leibniz University Hannover, Germany

An introduction and a report on the current state of the eHALOPH and the SUSTAIN databases is presented. Different approaches will be shown how the data in eHALOPH can be utilized in a meaningful way, also supported by AI. It will be demonstrated how the SUSTAIN database can be filled with literature data by using different methods. The approaches will be discussed for further applications in the SUSTAIN action.

Keywords: eHALOPH database, SUSTAIN database

Salt Stress Tolerance in Cultivated and Wild Lettuce: Genotype Screening and Root-Zone Mitigation by Exogenous Compounds

[WG2] *Oral Presentation*

Alessandro Esposito12, Alessandro Miceli2, Filippo Vetrano2, Alessandra Moncada2, Ivan Paponov1

1Aarhus University, Denmark; 2University of Palermo, Italy

Salinity is a major constraint in hydroponic lettuce production, requiring both the identification of tolerant genotypes and effective mitigation strategies.

This study followed a two-phase approach. In Trial 1, seven Lactuca spp. genotypes, including three L. sativa cultivars and four wild accessions, were characterized for morpho-physiological traits and evaluated for salt tolerance under 0 or 60 mM NaCl. In Trial 2, the sensitive but commercially relevant genotype TKI-122 was used to test whether root-applied exogenous compounds could alleviate salt stress.

In Trial 1, salinity significantly reduced biomass and leaf area in most genotypes, but the response was strongly genotype dependent. TKI-122 and the wild genotype TKI-252 were the most salt-sensitive, whereas TKI-126 and TKI-257 showed the highest tolerance, maintaining biomass and growth under saline conditions. In Trial 2, salicylic acid at an intermediate concentration (0.1 µM) was the most effective treatment, fully restoring fresh and dry biomass, leaf area, relative growth rate, and nitrogen balance index to levels comparable with the non-saline control. Low-dose

ascorbic acid, L-alanine, and L-tryptophan also improved salt tolerance, although less effectively. In contrast, methyl jasmonate and high concentrations of sodium nitroprusside and glutathione caused severe growth inhibition.

These results highlight substantial genetic variation in lettuce salt tolerance and identify root-zone application of salicylic acid as a promising strategy to improve the performance of sensitive lettuce genotypes under saline hydroponic conditions.

Keywords: salinity, hydroponics, Lactuca spp., genotype screening, salicylic acid

Acknowledgements: The study was supported by AUFF NOVA (Project number: 41366): Dissolved Organic Nitrogen as a Nitrogen Source for Plant Use.

Microbiome phenotyping for evaluating salinity-adapted intercropping systems in a Mediterranean table grape orchard (Murcia, Spain)

[WG2] *Oral Presentation*

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Soil salinization is a major constraint for Mediterranean agriculture and can strongly affect plant performance as well as the metabolic activity of soil microbial communities. Within the SaltyBEATS project, we evaluate whether halophyte-based intercropping can support biological functioning in a salt-affected table grape commercial orchard. The experimental field is located in Guadalentin Valley (Alhama de Murcia, Murcia, Spain), on a commercial agricultural soil exposed to an increasing salinity gradient (EC range 4-7 dS/m). It includes reference table grape subplots under monoculture and table grape-halophyte intercropping variants, providing a framework for comparing microbial functional responses under contrasting salinity conditions.

This presentation will focus on preliminary phenotyping results obtained from samples collected at the baseline stage in May 2025 and during June and July 2025. Phenotyping was performed under moderate (control) and elevated salinity conditions, allowing comparison of the capacity of microbial communities associated with control and intercropped soil samples to maintain metabolic activity under saline conditions.

Soil characterization provides context for interpretation: electrical conductivity differed significantly between control and saline areas, whereas soil pH remained relatively stable with values around 8-8.2. These observations support phenotyping as an early indicator of functional adaptation in salinity-stressed agroecosystems. Microbiome analysis is planned as the next step to link the observed phenotypic responses with bacterial and fungal community composition and to assess whether intercropping with halophytes enhances biodiversity-related resilience. Preliminary findings suggest that halophyte-based intercropping may represent a promising nature-based solution to maintain soil functionality under high salinity conditions. These results support the experimental approach for assessing how intercropping may enhance biodiversity-related resilience to salt-affected soil degradation in Mediterranean orchards.

Acknowledgements: Funding: This work was supported by the Biodiversa+ European Biodiversity Partnership under the BiodivNBS call and by the National Science Centre, Poland (NCN; UMO-2024/06/Y/NZ9/00139), within the SaltyBEATS project.

Picturing Natural Variation in Arabidopsis Root Architecture in Response to Salinity by Merging Growth Parameters and Genomic Information

[WG2] *Oral Presentation*

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Soil salinity is one of the most severe abiotic stress factors threatening agriculture worldwide. Hence, particular interest exists in unravelling mechanisms leading to salt tolerance and improved crop plant performance on saline soils. Salinity tolerance is understood to be polygenically controlled and the plant response to salt stress in different parts of plant body takes place at different spatial and temporal scales. Roots are exposed directly to salt and regulate ion, nutrient and water uptake as well as the transport within the plant. Therefore, understanding the effect of salinity on the root system is a prerequisite for plant improvement. Nineteen accessions of A. thaliana (Bur-0, Can-0, Col-0, Ct-1, Edi-0, Hi-0, Kn-0, Ler-0, Mt-0, No-0, Oy-0, Po-0, Rsch-4, Sf-2, Tsu-0, Wil-2, Ws-0, Wu-0, Zu-0) were tested for alterations in primary, lateral and total root length, as well as lateral root count after thirteen days of growth on MS medium with or without 50 mM NaCl or 100 mM NaCl. Clustering analysis was performed to detect similarities in root architecture among those accessions and revealed groups of distinct growth responses. A clear dose-dependent root response was observed since the clustering differed depending on the level of salinity. From available genome sequence data of those accessions, polymorphisms in coding sequences were extracted and matched with root response pattern, directly linking genotype and phenotype. Gene candidates identified by this approach are involved in phytohormone-related signalling, while for some of them no function is described yet. Testing of T-DNA insertion lines of these genes for their salt stress response confirmed their putative role in the root's adjustment to salinity.

Keywords: root morphology, reverse genetics, in vitro

Harnessing Native Mediterranean Plants for Climate-Resilient Diets, Ecosystem Restoration, and Saline Soil Sustainability

[WG2] *Oral Presentation*

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Drought and salinity represent two of the most urgent challenges confronting Mediterranean ecosystems, impacting both natural habitats and agricultural production. Native plant species traditionally consumed in the Cretan Mediterranean Diet are well adapted to abiotic stressors and represent an underexploited resource for conservation and ecosystem restoration initiatives.

This study assessed abiotic stress tolerance in 20 edible native Mediterranean plant species. A total of 2,860 plants were established across a broad range of soil conditions on the island of Crete (Greece), including agricultural systems, natural ecosystems, and urban green spaces in both private and public settings. The plants were subjected to abiotic stress conditions such as gradual reduction of irrigation, exposure to saline environments, and establishment in nutrient-poor soils, among others, and were monitored for a minimum period of five years.

Simultaneously, a systematic review of the existing literature was carried out to substantiate the empirical results and to determine additional uses of the edible plant species assessed. According to the results, 18 of the plant species studied exhibit significant medicinal properties, 12 have industrial applications, and 11 are used in cosmetology. This study demonstrates the broad potential of these plant species and their relevance for emerging value chains. It also supports their integration into planting decision-support tools and land use strategies, particularly in areas affected by salinity and other abiotic stressors, to advance sustainable land and water management within and beyond the Mediterranean.

Keywords: Salinization, Cretan Diet, Wild Edible Plant Species, Abiotic stressors

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Sustainable Intercropping of Arthrocaulon macrostachyum and Table Grape (Vitis vinifera L.) to Enhance Production in Salinity-Affected Soils

[WG2] *Oral Presentation*

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Southern Europe, particularly Spain, has one of the highest concentrations of saline soils. Approximately 100,000 ha of irrigated land in southeastern Spain are affected by, or at risk of, soil salinity, where soils are highly calcareous and groundwater quality is poor, with electrical conductivity (EC) values of 5–6 dS/m. Halophytic plants are emerging as a potential strategy to support crop production under saline conditions. In this context, clonal *Arthrocaulon macrostachyum* plants, tolerant to 30 g/L NaCl, were introduced into a commercial table grape orchard. The study was conducted in the Guadalentín Valley (Alhama de Murcia, Murcia, Spain), on agricultural land exposed to an increasing salinity gradient (EC 4–7 dS/m). The experimental design includes reference table grape monoculture plots and table grape–halophyte intercropping systems. Initially, two zones with different salinity levels were observed (March 2025, mean EC values of 5–9, dS/m, respectively), but over the long term, salinity levels converged to approximately 7 dS/m in both zones. Nevertheless, trees located in the previously more saline zone showed lower stomatal conductance and reduced chlorophyll content. However, intercropping does not mitigate the salinity-induced decline in chlorophyll. Nevertheless, no negative effects on photosynthesis were observed, suggesting that adaptive mechanisms are likely induced to protect photosynthetic performance. We also observed salinity-induced oxidative stress, as well as a reconfiguration of the antioxidant metabolism, characterized by increased APX and GR activities and decreased MDHAR activity. This pattern suggests an enhanced capacity to detoxify H_2O_2 and recycle GSH, alongside a reduced capacity to regenerate ascorbate. Overall, the influence of intercropping with *A. macrostachyum* on table grape plants was not very pronounced, whereas the effect of salinity was more significant. However, metabolomic analysis revealed a clearer separation of samples due to

intercropping than due to salinity. The presence of *A. macrostachyum* induced metabolic changes in leaves, affecting triggers key pathways related to plant defense, membrane stability, and secondary metabolism. Overall, salinity had a stronger impact on grapevine physiology than intercropping, although *A. macrostachyum* induced only subtle physiological effects but a clearer metabolomic reprogramming effect.

Acknowledgements: Funding: This study was supported by the Spanish State Research Agency (AEI) within the project Salty symphonies: bringing back Biodiversity in marginal saltlands (SaltyBEATS) (Ref. Biodiversa2023-27; PCI2025-163138), funded under the Biodiversa+ initiative.

WG3 – Total value of saline ecosystems and landscapes

Chair: *Zenepe Dafku*

Use of salt-tolerant Atriplex species in arid and semi-arid regions in Türkiye

[WG3] *Oral Presentation*

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Introduction

Atriplex species are resilient halophytes that flourish in saline and arid environments where traditional crops fail. In Türkiye, these plants offer a strategic solution for restoring unproductive lands degraded by high salinity levels. These plants provide stability in sensitive zones.

Methods

This review examines the ecological suitability of these taxa. It evaluates agricultural practices for Atriplex nitens, recommending mid-March seed sowing and harvesting at the end of the vegetative period to ensure optimal forage quality.

Results: Atriplex nitens is consumed in Anatolia when harvested early (10–20 cm) or used for high-quality animal feed. It's remarkable salinity and drought resistance allow it to germinate and survive under extreme stress. Floristic records confirm that Atriplex taxa are widely distributed across Türkiye, emphasizing their suitability for use within arid and semi-arid zones.

Conclusions

These plants represent sustainable options for erosion control and rehabilitation projects in challenging regions. They provide essential forage for local communities while restoring unproductive ecosystems. Consequently, Atriplex remains a resource for future sustainable agricultural management and conservation strategies

Keywords

forage crop, salinity tolerance, ethnobotany, halophyte, rehabilitation

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WG4 – Knowledge sharing and stakeholders' engagement

Chair: *Ozkan Elmaz*

Assessing Entrepreneurship Potential in Salt Affected Agricultural Lands: A SWOT Analysis Based Study

[WG4] *Oral Presentation*

Yaşar Selman Gültekin-Pınar Gültekin

Düzce University Faculty of Forest

Soil salinity is a significant environmental problem that limits agricultural production and increases economic vulnerability in rural areas. However, saline agricultural areas offer potential for innovative entrepreneurship models due to their unique ecological conditions and alternative production opportunities. This study aims to evaluate entrepreneurial activities in saline agricultural areas in terms of sustainable rural development.

The SWOT analysis method was applied in areas of Turkey where saline agricultural areas are prevalent. During the analysis process, strengths, weaknesses, opportunities, and threats related to entrepreneurship in saline agricultural areas were identified using existing literature, official reports, and secondary data. The SWOT analysis comprehensively addressed entrepreneurial areas such as salt-tolerant crop production, product diversification, agro-ecotourism, increasing the added value of local products, and nature-based solutions.

The findings reveal that entrepreneurship in saline agricultural areas can create economic opportunities and contribute to environmental sustainability with appropriate strategies and support mechanisms. The study demonstrates that SWOT analysis is an effective analytical tool for assessing the entrepreneurial potential of saline agricultural areas and provides guidance for policymakers and local actors.

Keywords: Salt-affected agricultural lands, entrepreneurship, SWOT analysis, rural development, sustainability, Türkiye

WG5 – Policy framework for the salinisation management

Chair: *Ozkan Elmaz*

Human Security and Ethical Aspects in the Policy Framework Development for a Better Salinisation Management

[WG5] *Oral Presentation*

Serghei Sprincean, PhD

Moldova State University

Introduction

The accumulation of soluble salts in soil and water, threatens agriculture, freshwater supplies, and livelihoods, particularly in arid and semi-arid regions. From a human security perspective, it undermines food security, economic stability, health, and social cohesion. Farmers facing declining yields and contaminated water often experience income loss, indebtedness, and displacement.

Methods

Therefore, policy frameworks for salinisation management must go beyond technical soil remediation and incorporate social protection, equitable resource governance, and long-term sustainability. Ethically, salinisation management raises questions of justice, responsibility, and participation.

Results

In many regions, salinity results from irrigation practices, upstream water diversion, or industrial activities that benefit some groups while imposing costs on others. Policies must address this imbalance through the “polluter pays” principle and by ensuring that vulnerable communities are not disproportionately burdened. Intergenerational equity is also critical: unsustainable land and water practices compromise the rights of future generations to productive ecosystems. Inclusive decision-making is another ethical cornerstone. Farmers, indigenous communities, and local stakeholders should be actively involved in designing and implementing management strategies. Transparent data sharing, access to extension services, and fair compensation mechanisms enhance trust and accountability. Gender considerations are equally important, as women often play central roles in water management and household food security.

Conclusions

A robust policy framework for salinisation management integrates scientific innovation with ethical governance. By aligning environmental sustainability with human rights and social justice, policymakers can safeguard both ecosystems and the well-being of present and future populations.

Keywords

salinisation management, environmental sustainability, policy framework

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MAPPING SOIL SALINITY HOTSPOTS AND RECOVERY ZONES IN TÜRKİYE: A NATIONAL-SCALE SENTINEL-2 TREND ANALYSIS

[WG5] *Oral Presentation*

Mehmet Ali Çullu

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Mehmet Ali ÇULLU, Miraç KILIÇ, Özkan ELMAZ, Hikmet GÜNAL, Ali Volkan Bilgili

ABSTRACT

Introduction

Soil salinization is a primary land degradation mechanism that alters pedological processes and restricts the ecological and economic sustainability of agricultural lands across Türkiye. This problem originates not from geogenic sources (parent material) alone, but also from secondary salinization processes triggered by inadequate irrigation management, rising groundwater tables, insufficient subsurface drainage infrastructure, and semi-arid climatic conditions. Evaluating the long-term pedo-dynamics of salinity problems at national scales requires multi-temporal satellite observations.

Methods

A spatio-temporal change analysis spanning the 2017 to 2024 period was conducted across 7285.35 km² of agricultural land situated in various pedo-climatic zones of Türkiye. The study utilized 43 distinct ground truth data from land survey locations as the assessment baseline. Sentinel-2 Level-2A surface reflectance composites at 10 m spatial resolution, processed via Google Earth Engine, served as the primary observation dataset. Surface soil salinity and vegetation response were quantified through the Salinity Index (SI) and Normalized Difference Vegetation Index (NDVI) using a 500 m focal mean aggregation. Inter-annual spectral trend magnitudes were determined via the Theil-Sen median estimator, statistical significance was evaluated using the Mann-Kendall trend test (using Kendall's tau, τ), and inter-index relationships were modeled via the Pearson correlation coefficient (r).

Results

Over the eight-year analysis period, the highest area-weighted mean SI (ranging between 0.209 and 0.232) was recorded in crop areas corresponding to the moderate salinity class according to the ground truth. Trend analyses demonstrated that 41 out of the 43 observed ground truth data from land survey sites lacked statistically significant linear changes in SI and NDVI parameters. Conversely, two adjacent ground truth data from land survey locations categorized as "extreme" salinity, located in the southern basin of the Harran Plain (specifically the Akçakale district), exhibited significant SI decreases indicative of active soil leaching. The respective soil amelioration trends for the first and second Akçakale measurement sites were -0.0047 $year^{-1}$ (τ = -0.785, p = 0.0055) and -0.0050 $year^{-1}$ (τ = -0.785, p = 0.0055). Concurring with the improved hydro-physical soil conditions, simultaneous biological recovery was observed in these specific Harran Plain sites; the increase in vegetative density (NDVI) occurred at rates of +0.0112 $year^{-1}$ and +0.0118 $year^{-1}$ (aggregate p = 0.0055).

Conclusions

During the 2017-2024 timeframe, more than 95% of the monitored agricultural ground truth data from land survey sites across Türkiye maintained a static pedological state without transitioning to extreme secondary salinization. The physicochemical improvement (decrease in SI values) and increase in biomass (increase in NDVI values) definitively observed in the highly saline areas of the Harran Plain (Akçakale) have emerged as a direct result of targeted subsurface drainage networks and active soil filtration interventions, rather than general regional climate changes. Integrating multi-temporal Sentinel time-series with non-parametric estimators provides a consistent monitoring system for updating field-based soil inventories and assessing the efficacy of regional land reclamation interventions.

Keywords: Salinity mapping, Türkiye, Sentinel image, trend analysis

WG6 – Network communication and dissemination of results

Chair: *Catarina Gomes*

POSTER PRESENTATIONS

Chair: *Eleftheria Dalmaris*

WG1 – Soil and water salinity: physical and biochemical characteristics at different scales

Soil reclamation under organic management in a Mediterranean saline–sodic polder: effects of gypsum–sulphur–manure amendments and tillage

[WG1] *Poster*

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Salt-affected Mediterranean polders are difficult to reclaim under organic farming because amendment options are limited and shallow groundwater drives strong seasonal salt redistribution. In the Raša River valley (Croatia), we evaluated gypsum–sulphur–manure strategies and tillage loosening vs. discing in a 4-year oat–triticale–barley–oat rotation (2016–2019) on a calcareous saline–sodic Anthrosol. We compared discing vs. discing + deep ripping and six amendment treatments: control, gypsum (G3), gypsum+sulphur at two rates (G3S1; G6S2), gypsum+sulphur+farmyard manure (G3S1+OM), and gypsum+farmyard manure (G6+OM). Soil physical (WHC, SWC, BD, PR, WSA) and chemical properties (pH, EC, OC, TN, exchangeable cations, ESP) were assessed at the start and end of the trial. Over time, EC declined and pH decreased across treatments, reflecting strong hydrological forcing, while gypsum-based amendments increased exchangeable Ca and reduced ESP, indicating sodicity alleviation. Structural improvement was recognized by higher WSA by 2019 (with the control remaining the weakest), and ripping generally lowered BD and PR, particularly in the subsoil. Yield responses were most evident in the later years, with the highest oat yields in 2019 under G6S2, G3S1+OM and G6+OM. Practically, the most robust organic strategy combined a sustained Ca source (gypsum, with or without sulphur) with manure to support structural recovery, complemented by periodic deep loosening where subsoil compaction limits rooting.

Keywords: gypsum; elemental sulphur; farmyard manure; ripping tillage; organic farming; soil structure; reclamation

Acknowledgements: This work was supported by the project “Building climate resilience via large scale uptake of systemic solutions in agricultural ecosystems in the Pannonian region” (ClimaPannonia) (Horizon Europe, Grant agreement ID: 101156281) and COST Action SUSTAIN (“Sustainable use of salt-affected lands” - CA22144) supported by European Cooperation in Science and Technology, www.cost.eu.

Drought amplifies estuarine salinity through reduced freshwater discharge

[WG1] *Poster*

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University of Geneva

Hydroclimatic variations strongly affect salinity fluctuations in semiarid estuaries through the regulation of water discharge and salt flushing mechanisms. In the present research, we analyze the interannual variability in the Gambia River Estuary at the Sahel-Guinea climatic transition, using data from two consecutive years (2024–2025).

The precipitation deficit of 14.5% across the entire basin prior to the dry-season of 2024 led to insufficient recharge and streamflow, hence incomplete salt flushing and increased baseline salinity for the subsequent season. This resulted in hypersaline conditions (≥35 PSU) in the lower estuary area, accounting for 71% in 2024 compared to 17% in 2025. Stable isotopes indicate comparable evaporative enrichment between years, suggesting that the differences were driven by freshwater discharge.

We show that hydroclimatic events regulate the salinity gradient along the longitudinal axis during a single season. Reduced river flow in semiarid climates causes salt accumulation and increased retention time, resulting in an elevated salinity level during the late stages of the dry seasons. It is shown that changes in salinity levels are largely regulated by the climatic conditions, especially the hydrological regime, within semiarid estuaries. Persistent droughts could result in salinization due to insufficient flushing of fresh water.

Keywords: Hydroclimate variability, Estuarine salinity, Freshwater discharge, Sahel, Stable Isotopes

Acknowledgements: Fieldwork and sample logistics were made possible through collaboration with the GREAT Institute in The Gambia. We thank the Isotope Geochemistry Laboratory (ISOLAB) at the University of Lausanne for access to laboratory facilities and support during isotope analysis. Support was provided

through the SFM Project (Sail for Mangroves in The Gambia) by the Office of Naval Research (Award Number N629092412033).

Filtering endophytic microbiomes from the rhizosphere environment by endemic Limonium plants

[WG1] *Poster*

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The genus Limonium includes thirteen species in Tuscany (Italy), twelve of which are endemic. Populations of Limonium etruscum occur in limited coastal habitats such dunes, saline salty sandy substrates, and salt steppes or meadows. Adaptations of this species to harsh saline soil conditions make it an interesting model for studying plant–microbiome interactions.

In May 2025, a pilot experiment was conducted to examine diversity (alpha, beta) and predicted metagenome functions of endophytic microbial communities (bacteria, fungi) associated with L. etruscum. Additionally, the metabolic diversity of microbial communities in the rhizosphere was analyzed.

The results indicate that L. etruscum selectively filters microorganisms from the rhizosphere, allowing only a limited number of relatively rare bacterial and fungal taxa to colonize aboveground plant tissues. This selective recruitment suggests strong host-driven filtering of microbial communities.

These findings provide the first insights into the holobiont of L. etruscum and highlight promising directions for future in vitro experiments and metabolomic studies.

Keywords: salinity, amplicon analysis, metabolic profiling

Acknowledgements: Funding: Biodiversa+ European Biodiversity initiative (BiodivNBS) and the National Science Centre (NCN, Poland) (UMO-2024/06/Y/NZ9/00139) SaltyBEATS project.

Soil Salinity in Albania

[WG1] *Poster*

Suela Spahiu

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Soil salinity and contamination represent important challenges for sustainable agricultural development in Albania, particularly in lowland and coastal areas. This study provides an overview of soil information systems, soil classification, and monitoring practices in the country. Data are based on national soil maps, the Agricultural Soil Inventory Program, and the Environmental Monitoring Program, which include key indicators such as electrical conductivity, exchangeable sodium, and heavy metal content.

Results show that saline soils (solonchaks and solonetz) occupy a limited but significant portion of agricultural land, while a large share of soils has been mapped and integrated into GIS-based systems. However, soil degradation is influenced not only by natural conditions but also by anthropogenic factors such as industrial activities, mining, oil extraction, and excessive use of agrochemicals.The study highlights the progress made in soil monitoring and digitalization, as well as the need for improved soil management practices, updated legislation, and further assessment of contamination levels. Strengthening monitoring systems and promoting sustainable land use are essential for protecting soil resources and ensuring long-term agricultural productivity in Albania.

Keywords: Soil salinity; Soil contamination; Soil monitoring; GIS; Sustainable land management; Albania

Acknowledgements: Ministry of Agricultural and Rural Development, Center for Agricultural Technology Transfer, Fushë-Krujë, Albania, National Environmental Monitoring Program

References:

National Soil Classification of Albania, Soil Monitoring Program Reports, Gis Soil information system Albania.

Salinity in the Desertification Process Using an AHP-Based Decision Support Model: Sub-Watershed Scale

[WG1] *Poster*

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Global climate change is leading to disruptions in hydrological balance, increased soil salinity, and consequently, accelerated desertification processes, particularly in semi-arid and arid regions. In Turkey, the Central Anatolian Region is among the areas susceptible to salinity-induced desertification due to low rainfall, high evaporation rates, declining groundwater levels, and intensive irrigation-based agricultural practices. The main objective of this study is to develop a holistic decision support model based on the Analytical Hierarchy Process (AHP) to monitor and evaluate the impact of salinity on the desertification process.

In this study, physical, chemical, biological, and hydroclimatic factors affecting desertification were evaluated hierarchically within the framework of the AHP approach. Basic salinity indicators such as soil electrical conductivity (EC), exchangeable sodium percentage (ESP), and sodium adsorption ratio (SAR) were considered as the main determinants of the model. Pairwise comparisons based on expert opinions were performed using Super Decisions software, and the consistency rates were determined to be at acceptable levels. The model was structured to reveal the direct and indirect effects of salinity on desertification susceptibility.

The results indicate that chemical soil properties play a decisive role in the desertification process in Central Anatolia. Soil salinization is both a trigger and an accelerator of the desertification process in 20% of the region. Increasing salinity leads to weakening of vegetation, decrease in biomass production, and increased erosion susceptibility. Temperature increases and irregular rainfall associated with climate change increase the risk of secondary desertification, especially in closed basins.

In conclusion, this AHP-based approach offers an effective decision support tool for monitoring salinity-induced desertification and prioritizing sensitive areas. Improving irrigation water quality, strengthening drainage systems, using salt-tolerant plant species, and climate change-adaptive land planning stand out as priority strategies for sustainable land management.

Keywords: Desertification, Soil Salinity, Analytical Hierarchy Process (AHP), Land Degradation, Sustainable Land Management

Anatomical Adaptations in Halophytes under heterogeneous conditions of saline soils

[WG1] *Poster*

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Introduction

The nature of many anatomical adaptations of halophytes is xeromorphic, because of the physiological drought occurring in saline environments. Halophytes evolved different anatomical

strategies to deal with environmental stresses (salinity, drought, waterlogging), thus defining themselves as stress resilient plants.

Methods

A number of 50 halophytes species were collected from heterogeneous salinized areas from Romania, Spain, and Polland. Cross-sections through vegetative organs were performed and then stained with carmine red and green iodine, and finally fixed into glycerol-gelatin. The permanent slides were examined with a light microscope and micrographs were taken using a Canon photo digital camera.

Results

Within these adaptations, succulence may have a dilution effect on accumulated toxic salts within plant tissues and plays a water storage role during dry periods. Intense lignification linked to successive cambia activity in roots and stems of halophytic chenopods could be also related to salinity and aridity. Salt secretion is an important strategy of recretohalophytes (crynohalophytes); salt glands and salt bladders are involved in the secretion of salt excess from aerial organs toward the exterior of halophytes. Kranz anatomy pattern occurs in C4 halophytes as a physical support for physiological and biochemical processes typical for C4 pathway. Bulliform or motor cells act in “amphibious halophytes” for rolling up the leaf during extended drought periods.

Conclusions

In halophytes, anatomical adaptations are strongly influenced by environmental factors, reflecting a close correlation between structure and habitat.

Keywords: Halophytes, Succulence, salt secretion, Kranz anatomy

Acknowledgements: SUSTAIN Cost Action CA22144 - Sustainable use of salt-affected lands

WG2 – Plant responses to salinity at the shoot and the root level

Planetary Resilience by Design

[WG2] *Poster*

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As climate volatility intensifies, Europe’s 2030 Green Deal and 2050 climate neutrality goals demand a shift toward crop breeding systems engineered for planetary resilience. Planetary Resilience by Design (PRD) outlines a 2075 roadmap integrating pangenomics, multi-omics, AI-guided gene editing, and speed breeding within a unified data-centric pipeline. Central to this framework is the Pan-Eco-Genome platform, which combines annotated pan-genomes of crops and wild relatives with sustainability metrics such as carbon and water footprints and nutrient use efficiency. The system enables structural variant discovery to identify resilience alleles, multi-omics integration (transcriptomics, epigenomics, phenomics, single-cell omics) to resolve genotype–phenotype relationships, and AI-driven CRISPR-based editing to enhance stress tolerance and nutritional traits. Speed breeding facilities with digital twins simulate future climates, while life cycle analysis (LCA)-guided selection promotes low-emission and regenerative traits. Digitally integrated breeding hubs can reduce cultivar development cycles to under five years. Case studies, including perennial wheat and nitrogen-efficient barley, demonstrate feasibility. Supported by evolving EU regulatory frameworks, PRD provides a phased policy–science roadmap: omics node development (2025–2040), integrated breeding hubs (2040–2060), and monitored field deployment (2060–2075), culminating in resilient, climate-smart crops ethically aligned with sustainability, equity, and food security goals.

Keywords: Pangenomics; Climate-smart crops; CRISPR gene editing; Multi-omics integration; Sustainable breeding; Digital agriculture

Coordinated NHX-mediated ion sequestration and antioxidant responses drive short- and long-term salinity tolerance in quinoa

[WG2] *Poster*

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Salinity stress severely constrains crop productivity, necessitating a deeper understanding of physiological and molecular tolerance mechanisms in halophytic species such as quinoa (Chenopodium quinoa Willd.). This study investigated short- and long-term salinity responses in two quinoa genotypes. Plants were grown for three weeks prior to stress imposition and subsequently exposed to 300 mM NaCl for seven weeks under greenhouse conditions. Photosynthetic performance, chlorophyll content, lipid peroxidation, H_2O_2 accumulation, proline content, antioxidant enzyme activities, and ion (Na, K, Cl, Ca) distribution in roots, leaves, and isolated vacuoles, as well as NHX gene expression profiles, were assessed after two and seven weeks of salinity. Soil electrical conductivity and ion composition were also monitored. Both genotypes completed their life cycle and produced seeds under salinity. However, the tolerant genotype exhibited superior adaptive responses. This genotype accumulated higher Na levels in roots and leaves, with pronounced vacuolar sequestration, coinciding with significant upregulation of NHX transporters, particularly in roots. Enhanced antioxidant capacity and osmoprotectant accumulation further contributed to stress mitigation. Collectively, these findings highlight NHX-mediated ion compartmentalization and coordinated antioxidant responses as key determinants of salinity tolerance in quinoa, providing valuable insights for breeding resilient crops under saline environments.

Keywords: Quinoa; Salinity stress; NHX transporters; Vacuolar sequestration; Antioxidant defense

Investigating salinity tolerance in Strombocarpa strombulifera: A molecular perspective on a mucilage-producing halophyte

[WG2] *Poster*

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Understanding how halophytes tolerate high salinity can reveal molecular strategies for improving crop resilience. Strombocarpa strombulifera, a halophyte abundant in the saline regions of central Argentina, shows contrasting responses to different salts, tolerating NaCl concentrations up to ~1 M, whereas Na_2SO_4 inhibits growth.

This work focused on sulfate transport, combining molecular analysis of sulfate transporters with sulfur distribution under saline conditions. Members of the sulfate transporter family (SULTR1.1–SULTR4.2), which mediate sulfate uptake and its movement between roots and shoots, were analyzed at the gene expression level to evaluate their regulation under different salt treatments.

By addressing the regulation of sulfate transport in Strombocarpa strombulifera, this study contributes to a better understanding of physiological mechanisms underlying plant responses to treatments with different salts.

Keywords: Strombocarpa strombulifera; SULTR gene expression; salt-specific regulation

Drought-induced metabolic shift, flavonoid biosynthesis, and chalcone synthase upregulation underpin cultivar-specific drought stress resilience in Lotus corniculatus

[WG2] *Poster*

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This study investigated drought-induced morphological, physiological and molecular responses in three Lotus corniculatus L. (birdsfoot trefoil, BFT) cultivars (‘Gelsvis’, ‘Baco’, and ‘Izis’) under progressive water deficit conditions (100% field capacity (FC) (control), 50 % FC (moderate) and 30% FC (severe)). Expression levels of chalcone synthase (CHS) gene family members (LcCHS3, LcCHS4, LcCHS10, LcCHS11, LcCHS12) and flavonoid biosynthetic genes (LcIFS2, LcFLS, and LcF3’H) were analyzed by qRT-PCR. The analysis of data revealed that drought significantly reduced plant height, bunch diameter, leaf dimensions, root length, leaf and branch number, chlorophyll content, and biomass traits across all cultivars. In contrast, water limitation triggered a metabolic shift towards enhanced secondary metabolite biosynthesis, leading to significant accumulation of quercetin and kaempferol derivatives, isoflavones, isoflavanes, and phenylpropanoid acids. The expression levels of genes encoding key flavonoid biosynthetic enzymes were compared among the cultivars. The upregulation of CHS and flavonoid biosynthetic genes was most pronounced under severe stress (30% FC). ‘Gelsvis’ exhibited superior drought resilience, characterized by coordinated transcriptional upregulation of biosynthetic genes accompanied by metabolite enrichment, and the maintenance of comparatively stable morphological performance. Multivariate analyses revealed antagonistic associations between growth traits and flavonoid pathway components, confirming a resource reallocation from primary growth to protective secondary metabolism under drought. This study demonstrates cultivar-specific adaptive responses of L. corniculatus under drought stress and identifies chalcone synthase upregulation as a central molecular mechanism contributing to drought tolerance. ‘Gelsvis’ exhibited superior transcriptional and metabolic plasticity compared with ‘Baco’ and ‘Izis’, making it a valuable genetic resource for breeding programs aimed at improving drought resilience in forage legumes

Keywords: Lotus corniculatus, Drought stress, Chalcone synthase (CHS), Flavonoid biosynthesis, Drought tolerance

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Salt-induced responses in the grain type of Amaranthus spp.

[WG2] *Poster*

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Introduction: Salinity is a critical environmental stressor that severely constrains the productivity of most crops, as well as the biodiversity of many plant species and living organisms worldwide. Among these, pseudocereals are emerging as alternatives to conventional staple crops, meeting the rising demand for high-quality nutrition, particularly given current global food challenges. To accurately characterize salt tolerance or sensitivity, it is essential to evaluate multiple plant responses to applied stress, including morpho-anatomical plasticity and adaptations.

Methods: Amaranth plants were initially cultivated in substrate for four weeks before being transferred to hydroponic Hoagland solution. Following a one-week acclimation period, the plants were subjected to saline conditions for two additional weeks. Post-treatment evaluations included

analysis of growth parameters, histological staining of primary root cross-sections, and examination of leaf imprints to identify salt-induced responses compared to controls. All experiments were conducted with at least three biological replicates per treatment.

Results: We observed a significant reduction in amaranth biomass accompanied by alterations in several root anatomical parameters. On the other hand, leaf traits, including both epidermal cell and stomatal densities, increased under salt-induced stress compared to controls.

Conclusions: Our findings show that salt stress elicits distinct morpho-anatomical modifications in amaranth plants.

Keywords: morphology, root, stomata, salinity

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WG3 – Total value of saline ecosystems and landscapes

Monitoring and Management of Soil and Coastal Salinization

[WG3] *Poster*

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Soil and coastal salinization pose major challenges to agriculture, ecosystems, and livelihoods, especially in arid and semi-arid regions. This study reviews recent advances in monitoring, modeling, and managing salinity using remote sensing, field surveys, machine learning, and biogeochemical analyses. Coastal wetlands and estuaries face degradation and fragmentation from urbanization and land-use change, with salinity-driven vegetation shifts, notably in Suaeda salsa on tidal flats. Groundwater dynamics and hydrological changes strongly influence soil salinity, as seen in the Western Songnen Plain and Yellow River Delta, where declining groundwater, variable precipitation, and human activities shape salinization patterns. High-resolution mapping with multispectral, hyperspectral, and SAR imagery, combined with algorithms like Random Forest and MSD-WGAN-GP, enables precise spatiotemporal assessment of salinity, including vertical profiles and ecological risk zones. Machine learning models enhance estuarine salinity prediction, highlighting the key role of climate–ecology interactions. Microbial community studies reveal resilience and adaptation mechanisms under salinity stress, suggesting bio-based strategies for saline agriculture. Integrated management such as aquifer recharge, drainage optimization, crop rotation, and wetland restoration effectively mitigates salinization and supports ecosystem services. Together, these approaches offer a multi-scale, interdisciplinary framework for understanding salinity dynamics, guiding precision management, ecosystem restoration, and sustainable land-use planning in salinization-prone areas.

Keywords: Soil salinization, coastal wetlands, remote sensing, ecosystem services, machine learning

Acknowledgements: CA22144 - Sustainable use of salt-affected lands (SUSTAIN)

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Harnessing Plant Growth-Promoting Bacteria to Increase Tomato Resilience to Salinity in Soilless Greenhouse Systems

[WG3] *Poster*

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Salinity is a major constraint to greenhouse horticulture, particularly in intensive soilless cultivation systems. The Sun2Fork project investigates the potential of plant growth-promoting bacteria (PGPB) to enhance tomato resilience under salinity stress. This study aims to identify effective PGPB consortia capable of improving tomato growth and physiological performance in soilless cultivation systems exposed to salinity stress, thereby contributing to more sustainable and resilient greenhouse production strategies.

PGPB consortia were selected based on their tolerance to salinity and their ability to express plant growth-promoting traits, including indole-3-acetic acid production, phosphorus solubilization, siderophore production, and nitrogen fixation, as well as their previously demonstrated capacity to promote plant growth under stressful conditions. The efficiency of the selected consortia was evaluated under greenhouse conditions at different salinity levels (0, 100, and 200 mM NaCl). Microbial consortia were applied by spraying onto the substrate surface in tomato soilless cultivation systems.

At harvest, plant responses were assessed through biometric parameters, including biomass and shoot elongation, and physiological indicators such as SPAD index. Additional stress-related parameters, including leaf relative water content, proline accumulation, and total soluble sugars are currently being evaluated to further characterize tomato responses to inoculation and salinity stress.

Preliminary results indicate that selected PGPB consortia can mitigate the negative effects of salinity on tomato growth in soilless systems. These findings highlight the potential of microbial consortia as sustainable strategy to improve crop tolerance to salinity stress and support more resilient greenhouse horticulture.

Keywords: Keywords: salt stress; microbial inoculants; soilless cultivation; Solanum lycopersicum

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From marginal to multifunctional: valorizing salt-affected lands through multifunctional ecosystem services

[WG3] *Poster*

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Traditionally, salt-affected lands have been categorized as degraded lands requiring intensive remediation. However, a shift toward a value-focused paradigm reveals these landscapes as "biological factories" capable of sustaining unique economic, social, and environmental services. In this poster, we bring new insights on the valorization of saline landscapes through halophytic agriculture, cultural agrotourism, and innovative business models in Italy. Several companies are integrating halophytic species into the local culinary heritage, valorizing salt-tolerant species while promoting a deeper connection between consumers and saline landscapes. Moreover, saline environments provide essential cultural ecosystem services with high recreational value, supporting agrotourism, botanical safaris, and traditional fishing practices, as exemplified by the Northern Venetian Lagoon where visitors can engage with ancestral fishing techniques while increasing biodiversity awareness. Finally, innovative business models like biosaline beekeeping further exemplify the socio-economic resilience of these lands. For example, the ability of numerous halophytes to persist in salinized lands across the Mediterranean region supports the production of

high-quality honey providing direct economic incentives for stakeholders to preserve saline landscapes. By aligning commercial interests with the restoration of key ecological functions, stakeholders can move beyond simple remediation toward the strategic production of climate-resilient assets, ultimately transforming environmental liabilities into sustainable economic opportunities.

Keywords: saltland valorization, agrotourism, halophytes, stakeholder engagement, beekeeping

Assessing Ecosystem Service Functions of Some Halophytes in Türkiye

[WG3] *Poster*

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Introduction: Türkiye's diverse coastal and inland saline habitats support various halophytes essential for ecosystem services. This study examines their functional roles in increasing coastal resilience, sustaining saline wetlands, rehabilitating degraded lands, and providing climate-related regulating services.

Methods: The research evaluates the contributions of key taxa specifically Salicornia spp., Suaeda spp., and Limonium spp. while reviewing the potential of microbiome-endophyte interactions and biotechnological models, such as Aeluropus littoralis, for improving salt tolerance and land management.

Results: Salicornia and Suaeda spp. are vital for primary production, soil stabilization, and carbon dynamics in saline ecosystems. Limonium spp. serves as key indicators of habitat health for littoral restoration. Furthermore, microbiome-endophyte interactions enhance halophyte productivity in marginal areas, while model species provide insights for transferring salt-tolerance traits to agricultural crops through breeding.

Conclusions: Halophytes demonstrate strong practical potential for coastal restoration and sustainable bioeconomy goals in Türkiye. Cultivating these species on marginal lands using soil and microbial amendments offers a viable, low-input strategy for sustainable land use and saline land management.

Keywords: Halophytes, ecosystem services, phytoremediation, salinity, Türkiye, coastal restoration

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Effective Use of Organic Fertilizers in the Biological Remediation of Saline Soils in Türkiye

[WG3] *Poster*

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Introduction: Saline soils in Türkiye pose a major challenge to agriculture, requiring integrated remediation approaches. Organic fertilizers and materials are vital supportive agents in the biological remediation of these soils, as they enhance physical structure and biological health. These inputs are essential for managing soil productivity and supporting plant growth under environmental stress

Methods: This study was developed by synthesizing findings from a diverse range of scientific studies performed in Türkiye, including greenhouse experiments, laboratory incubation trials, and field-based implementations.

Results: As a results of synthesizing findings from a diverse range of scientific studies performed in Türkiye, including greenhouse experiments, laboratory incubation trials, and field-based implementations. The process involved reviewing and aggregating data from the source material regarding organic amendments used alone or alongside gypsum to assess their collective impact on soil physical properties, chemical sodicity indicators, and nutrient mineralization processes.

Conclusions: Organic fertilizers in Türkiye function as critical complementary inputs rather than direct desalination agents. They are most effective when used to enhance leaching processes and vegetation-based remediation strategies, ensuring the sustainable reclamation of saline-sodic soils.

Keywords: Organic amendments, Salinity, organic matter, soil reclamation

Acknowledgements: This work is supported by the SUSTAIN 22144 project, COST (European Cooperation in Science & Technology), and is Funded by the European Union.

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WG4 – Knowledge sharing and stakeholders' engagement

Environmental Salinity and Its Implications for Animal Food Safety

[WG4] *Poster*

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Environmental salinity is emerging as a critical factor affecting livestock production systems and food security. Increasing salinity levels in soil and water not only impact plant-based feed resources, but also pose direct physiological challenges to animals, compromising the quality and safety of animal food products. High salt concentrations in drinking water and feed can lead to osmotic stress, dehydration, and metabolic imbalances in animals, which can lead to reduced growth performance, impaired immune function, and increased susceptibility to diseases. These physiological changes can significantly impact the safety and nutritional composition of animal foods such as meat, milk, and eggs. Furthermore, excessive sodium and chloride accumulation in animal tissues and dairy products can pose health risks to consumers, especially in populations sensitive to high sodium intake. High salinity in water sources can also contribute to heavy metal mobilization and microbial contamination, and can further exacerbate food safety concerns by increasing the risk of zoonotic pathogen transmission. Salinity fluctuations in aquaculture systems affect fish metabolism, stress responses, and microbial communities, leading to bioaccumulation of harmful substances in seafood. This study aims to provide a comprehensive analysis of the effects of environmental salinity on animal production and food security, and to highlight possible mitigation strategies. Adaptation approaches, including dietary interventions, selective breeding for salinity tolerance, and improved water and feed management practices, are crucial to sustain sustainable livestock production while ensuring food security. Understanding the interactions between salinity stress and animal physiology is important for developing resilient food production systems in the face of increasing environmental challenges.

Keywords: Environmental Salinity, Animal Food Safety, Livestock Production, Salinity Stress

SENSORY TESTS AND OUTREACH ACTIVITIES AS TOOLS FOR INCREASING CONSUMER ACCEPTANCE: INSIGHTS FROM THE XTREMEGOURMET 2.0 PROJECT

[WG4] *Poster*

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RiaFresh® produces several halophytes using soilless systems. The XtremeGourmet 2.0 project (XG2.0) aims to adapt to cultivation 3 additional species while partially replacing sodium with magnesium in 3 commercialized plants, preserving their nutritional and sensory quality. Despite growing interest in halophytes as culinary ingredients, commercialization remains largely within the fine-dining sector. Therefore, XG2.0 integrates sensory evaluation and targeted outreach activities to promote consumer education and consumption.

In this context, the sensory quality of Atriplex portulacoides (AP) cultivated under three salinity levels was evaluated by a trained panel of experts using the Just About Right test. Additionally, A. portulacoides, Mesembryanthemum nodiflorum, Disphyma crassifolium, and Crithmum maritimum were assessed by consumers using hedonic and Check-All-That-Apply tests. AP grown under the highest salinity conditions showed sensory attributes closer to the ideal. In the second trial, C. maritimum was the least appreciated species. Minerality, salt crystals, crunchiness, and saltiness shown a positive impact in the overall appreciation, whereas bitterness and astringency reduced acceptance. Overall, sensory evaluations support optimization of cultivation conditions and identification of preferred plants and attributes, while outreach activities engaged approximately 500

students across Portugal (ages 3–93) over 1.5 years, promoting awareness, and interest in novel foods, supporting future market uptake.

Keywords: Soilless cultivation; Consumer acceptance; sensory evaluation; public engagement

Acknowledgements: XtremeGourmet2.0 (COMPETE2030-FEDER-01195200) is funded by the Algarve2030 and Compete2030 programmes, and co-funded by the European Union.

WG5 – Policy framework for the salinisation management

Transgenic Approaches for Enhanced Salt Stress Tolerance in Perennial Crops

[WG5] *Poster*

Muhammad Tahir Khan

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Soil salinity is a major abiotic stress that adversely affects the growth, productivity, and sustainability of perennial crops across many regions of the world. With increasing land degradation and climate variability, developing salt-tolerant plant varieties has become a critical priority for modern agriculture. Transgenic approaches provide a powerful tool to enhance salt stress tolerance by introducing genes associated with key physiological and molecular mechanisms, including ion transport, osmotic adjustment, antioxidant defense, and stress-responsive signaling pathways. These genetic modifications can improve a plant's ability to maintain cellular homeostasis and sustain growth under saline conditions. Transgenic plants are typically developed using established transformation techniques and evaluated under controlled and field conditions to assess their performance. Key parameters such as growth, ion balance, and stress adaptation are used to determine the effectiveness of introduced traits. Overall, transgenic strategies hold significant potential for improving the resilience of perennial crops to salinity stress, supporting sustainable agricultural production and food security in salt-affected environments.

Keywords: salt stress, perennial crops, sugarcane

Acknowledgements: Lab members and research team Field staff SUSTAIN

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Developing a Multi-level Stakeholder Database for Salt-Affected Land Management: Insights from the SUSTAIN COST Action

[WG5] *Poster*

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Salt-affected lands represent a significant environmental and agricultural challenge across Europe, requiring coordinated action among diverse institutional actors. However, stakeholder information relevant to land management is often fragmented, non-standardized, and difficult to access across

countries. This study aims to develop a structured, multi-level stakeholder database to support knowledge exchange and stakeholder engagement within the SUSTAIN COST Action (Sustainable use of salt-affected lands) framework, as part of a Virtual Mobility Grant focused on addressing existing data gaps. Data were collected from multiple sources, including European umbrella organizations, national institutional websites, and COST Action member networks. A standardized database structure was designed, incorporating country, organization name, governance level (local, regional, national), organization type (e.g., authority, extension service, confederation), and contact information. The database currently includes organizations from multiple COST Action member countries, providing an initial overview of institutional distribution across governance levels and categories. Preliminary results indicate that national-level authorities and agricultural confederations are the most represented stakeholders, while extension services and local-level actors are less consistently documented. The study also highlights challenges related to data availability, the heterogeneity of institutional structures, and the limited accessibility of contact information. The developed database provides a practical foundation for organizing stakeholder engagement activities, such as webinars and targeted communication, and contributes to improving coordination and knowledge transfer in the management of salt-affected lands.

Keywords: Stakeholder mapping, Soil salinity management, Land management, Data harmonization

Acknowledgements: This work was supported by the SUSTAIN COST Action (CA22144) through a Virtual Mobility Grant. COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks.

An Assessment of Some Ecosystem Services in Soils Affected by Secondary Salinization in the Harran Plain

[WG5] *Poster*

Miraç Kiliç, Fatma Akbay Kiliç

Malatya Turgut Özal University

Secondary salinisation and alkalisation in semi-arid irrigated basins progressively damage upper soil horizons, causing measurable loss of ecological function. A subsurface drainage network was installed across the Harran Plain in 2012 to intercept capillarity-driven upward salt flux at the soil surface.

A stratified Before-After Control-Impact (BACI) framework was built on four electrical conductivity classes from a 2009 field salinity survey: non-saline, slightly saline, moderately saline, and saline-alkaline. Four temporal phases were defined: pre-intervention baseline (T0: 2008-2011), early recovery (T1: 2013-2016), mid-recovery (T2: 2017-2020), and recent state (T3: 2021-2025). Peak-summer composites (15 June-15 September) from Landsat 5 Thematic Mapper (TM) and Landsat 8/9 Operational Land Imager (OLI) imagery yielded three ecosystem service proxies: Soil-Adjusted Vegetation Index (SAVI; provisioning services, agricultural biomass production), Salinity Index (SI; regulating services, soil salt leaching efficacy), and Land Surface Temperature (LST; regulating services, micro-climate cooling). Class-stratified Mann-Whitney U, Kruskal-Wallis, and Mann-Kendall tests were applied.

In the saline-alkaline class, SAVI rose by +0.158, SI fell by 0.044, and LST decreased by 2.76 degC in T1 relative to the T0 baseline. The Kruskal-Wallis H statistic for SI across all four phases reached 688.87 ($p < 0.001$), the highest value recorded among all class-index combinations. Negative delta-SI, indicating net salt leaching, was recorded across 89.4% of the 2,046,529 analysed Landsat pixels.

Subsurface drainage produced concurrent improvements in provisioning and regulating ecosystem services in secondary-salinised soils under semi-arid climatic conditions.

Keywords: Secondary salinisation, BACI framework, ecosystem services, soil reclamation, remote sensing, Harran Plain

Turning Challenges into Oppurtunities: Using Salt-Tolerant Triticale to Support Agricultural Policies for Saline Lands

[WG5] *Poster*

Signem Oney-Birol

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Soil salinity is a major global challenge because it limits plant growth and reduces food security in arid regions. This study contributes to SUSTAIN COST Action WG5 (Task 5.1) by showing how salt-tolerant crops can turn environmental problems into economic opportunities for national and international agricultural policies.

Keywords: Saline Agriculture, Triticale, Salt Tolerance, Policy Framework, Food Security.

Acknowledgements: This study was supported by the Ministry of Development of the Republic of Türkiye under Project Number 2011K120220. The authors also acknowledge the support of COST Action SUSTAIN (CA22124).

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WG6 – Network communication and dissemination of results

Remote sensing approach for identifying and mapping saline soils in the national park of Khnifiss in the southwestern of Morocco.

[WG6] *Poster*

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Soil salinization is a major land degradation process in arid and semi-arid regions , driven by high evaporation rates, and saline groundwater discharge. In the southwestern of Morocco , extensive salt flats and saline depressions represent highly vulnerable ecosystems where soil salinity constrains land use and ecological functioning. This study aims to assess and map salt-affected soils in the national park of Khnifiss and its surrounding landscape using remote sensing techniques, providing a baseline for sustainable land management and long-term monitoring.

The analysis is based on Landsat 8 Operational Land Imager imagery acquired in 2021. Image processing followed a structured study including preprocessing, visual interpretation, image enhancement, supervised classification, and post-classification analysis. Field knowledge and ground observations were used to define regions of interest and validate classification results. To enhance the detection of saline soil types, normalized difference salinity indices derived from band ratios were applied. Gypsic soils were identified using the ratio between SWIR bands (Band 5 and Band 7), while natric soils were mapped using the ratio between SWIR and NIR bands (Band 5 and Band 4). These indices effectively minimize topographic and illumination effects while emphasizing spectral responses linked to soil mineralogy.

The results indicate that salt-affected soils occupy a substantial proportion of the study area, particularly in low-lying depressions and marginal zones of the salt flat. Saline crusts and salisols dominate the landscape, with spatial patterns closely linked to lithology and groundwater dynamics. The study confirms the efficiency of Landsat-based salinity indices for identifying gypsic and natric soils in hyper-arid coastal environments. The proposed approach offers a cost-effective and

replicable framework for mapping salt-affected soils and supporting sustainable land-use planning in arid and semi-arid regions.

Keywords: Soil salinity, remote sensing, Landsat images, arid and semi-arid regions, Gypsic soil

WORKING GROUPS

The SUSTAIN COST Action (CA22144) is organised around six Working Groups (WGs) that together address the scientific, environmental, socio-economic, policy and communication dimensions of the sustainable use of salt-affected lands. The titles, leadership and membership listed below reflect the information published on the official COST Action page.

Source: https://www.cost.eu/actions/CA22144/ (Working Groups and Membership).

WG TITLES AND LEADERSHIP

WG1 – Soil and water salinity: physical and biochemical characteristics at different scales

Leader: Mr Iraklis Pavlou
Vice Leaders: Prof Muhammad Saqib, Dr Hesam Mousavi, Dr Fatma Kaplan

WG2 – Plant responses to salinity at the shoot and the root level

Leader: Prof Jutta Papenbrock
Vice Leaders: Dr Ian C. Dodd, Prof Katarzyna Hrynkiewicz

WG3 – Total value of saline ecosystems and landscapes

Leader: Ms Zenepe Dafku
Vice Leaders: Dr Nuray Çiçek, Dr Elson Ian Nyl Galang

WG4 – Knowledge sharing and stakeholders' engagement

Leader: Prof Henrik Per Aronsson
Vice Leaders: Dr Sylwia Timoszuk, Ms Esteri Viitanen

WG5 – Policy framework for the salinisation management

Leader: Prof Vítor João Pereira Domingues Martinho
Vice Leader: Prof Ozkan Elmaz

WG6 – Network communication and dissemination of results

Leader: Ms Catarina Gomes Domingues
Vice Leaders: Dr Luísa Custódio, Ms Nour Bouriel

MEMBERSHIP

The following tables list all members registered in each Working Group. Members may be affiliated to more than one WG and therefore appear in the corresponding lists.

WG1 – Soil and water salinity: physical and biochemical characteristics at different scales

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Name	Country
Prof Crisanto Silva Aguilera	Venezuela
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Dr Adil Al-Salman	Germany
Prof Abdel Rahman Mohammad Said Al-Tawaha	Jordan
Dr BURAK ALAYLAR	Türkiye
Dr Basem Aljoumani	Germany
Dr Åsgeir Rossebø Almås	Norway
Dr NÜKET ALTINDAL	Türkiye
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Mr MUHAMMAD KASHIF AMAN	Italy
Prof Anna Andreetta	Italy
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Dr Iain Gould	United Kingdom
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Ms TAYYABA GULL	Italy
Dr fatih gökmen	Türkiye
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Ms Gamze Gündoğdu	Türkiye
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Prof Piotr Hulisz	Poland
Mr Mudassar Hussain	Lithuania
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Dr Mohamed El Mazlouzi	France
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Dr Stanko Milić	Serbia
Dr Hesam Mousavi	Norway
Ms Giulia Mozzo	Italy
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Prof Hristina Poposka	North Macedonia
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WG2 – Plant responses to salinity at the shoot and the root level

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Dr Aysegul Akpinar	Türkiye
Dr Emre AKSOY	Türkiye
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Prof Abdel Rahman Mohammad Said Al-Tawaha	Jordan
Dr BURAK ALAYLAR	Türkiye
Dr Francisco Pérez Alfocea	Spain
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Dr Ayşe Nilgün Atay	Türkiye
Prof Ersin ATAY	Türkiye
Ms Ghofrane Atrous	Spain
Dr Giulia Atzori	Italy
Dr Muhammad Ayaz	Lithuania
Mr Erkan Anıl AYDİN	Türkiye
Prof Murat Aydın	Türkiye
Mr Sefa Ayten	Türkiye
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Prof Faheem Shehzad Baloch	Türkiye
Dr Gregorio Barba-Espín	Spain
Prof Edward Barrett-Lennard	Australia
Dr Oqba Basal	Hungary
Prof Elias Bassil	Cyprus
Dr Nadia Bazihizina	Italy
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Prof Lorenzo Burgos	Spain
Dr Pedro Garcia Caparros	Spain
Dr Ana D. Caperta	Portugal
Dr Antonella Castagna	Italy
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Mr Jan Chluba	Germany
Prof M. Gonzalo Claros	Spain
Ms Oxana Climenco	Moldova
Dr José Antonio Hernández Cortés	Spain
Dr Luísa Custódio	Portugal
Dr Selda Daler	Türkiye
Dr Eleftheria Dalmaris	Greece
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Dr Alper DURMAZ	Türkiye
Prof Manal Eid	Egypt
Prof Melek Ekinci	Türkiye
Dr Fevzi Elbasan	Türkiye
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Prof Ahmed El-Hussein Elnewishy	Egypt
Prof Engin EROĞLU	Türkiye
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Prof Derya Eşen	Türkiye
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Dr Karen Ghazaryan	Armenia
Prof Cherki GHOULAM	Morocco
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Prof Faten Gorsane	Tunisia
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Mr Juan José Guerrero	Spain
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Ms TAYYABA GULL	Italy
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Ms Gamze Gündoğdu	Türkiye
Ms Selin Gündüz	Türkiye
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Dr Ines HARZLI	Türkiye
Prof Mirza Hasanuzzaman	Bangladesh
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Mr Jakob Herrmann	Germany
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Mr Muhammad Faizan Ilyas	Germany
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Prof Christian Magné	France
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Dr Isabel Marques	Portugal
Ms Rossella Mastroberardino	Italy
Dr Mohamed El Mazlouzi	France
Ms Carmen Jurado Mañogil	Spain
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Dr Maryam Mozafarianmeimandi	Hungary
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Prof Signem Oney-Birol	Türkiye
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Prof Furkan ORHAN	Türkiye
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Mr Michele Petrillo	Italy
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Dr Dejan Pljevljakušić	Serbia
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Dr Meisam Rezaei	Iran
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Mr Sebastian Rodas	Germany
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Dr Muge Sahin	Türkiye
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Ms Aimal Waheed	Lithuania
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Prof Evren YILDIZTUGAY	Türkiye
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Dr Xudong Zhang	Germany
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Dr Emine Sema ÇETİN	Türkiye
Dr Nuray Çiçek	Türkiye
Dr Gökçe Aydöner Çoban	Türkiye
Dr Selda ÖRS	Türkiye
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WG3 – Total value of saline ecosystems and landscapes

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Dr Muhammad Ayaz	Lithuania
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Dr Jorge Batlle-Sales	Spain
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Dr Tugba Gurkok-Tan	Türkiye
Prof Pınar Gültekin	Türkiye
Dr Yaşar Selman GÜLTEKİN	Türkiye
Prof Parisa GÜNEŞ	Türkiye
Mr Muhammad Fahad Hakim	Lithuania
Prof Karim Ben Hamed	Tunisia
Mr Muhammad Anwar Ul Haq	Italy
Dr Ines HARZLI	Türkiye
Prof Abdelaziz Hirich	Morocco
Prof Piotr Hulisz	Poland
Mr Waleed Iqbal	Lithuania
Dr Leila Jahanbazi	Denmark
Dr Zsembeli József	Hungary
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Mr Erdem Karagöz	Türkiye
Dr Maria-Anastasia Karatzia	Greece
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Dr Goda Lukoseviciute	Lithuania
Prof Milica Lukovic	Serbia
Dr Laura Malinauskaite	Iceland
Dr Ruhangiz Mammadova	Azerbaijan
Dr Ana Marques	Portugal
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Mr Matija Milic	Serbia
Prof Dubravka Milic	Serbia
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Dr Dejan Pljevljakušić	Serbia
Dr Giuseppe Puglia	Italy
Dr Muhammad Qaswar	Belgium
Dr Hafeez Ur Rahim	Italy
Dr Filippo Randelli	Italy
Dr Milica Rat	Serbia
Dr Niccolò Renzi	Italy
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Prof M. Sinan Taspinar	Türkiye
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Mr Pim van Tongeren	Netherlands
Dr Bülent Turgut	Türkiye
Dr Filiz HALLAÇ TÜRK	Türkiye
Mr Sana Ullah	Lithuania
Dr Pablo Carril Vaglini	Italy
Dr Mirjana Vukosavljev	Serbia
Ms Aimal Waheed	Lithuania
Prof Tugrul Yakupoglu	Türkiye
Dr AYTÜL YILDIRIM	Türkiye
Prof Cengiz Yücedağ	Türkiye
Dr Mustafa Emir Yücel	Türkiye
Dr Mehmet Salih Yıldırım	Türkiye
Dr Murat Yılmaz	Türkiye
Prof Ivan Zlatanovic	Serbia

Dr Meriç ÇAKIR	Türkiye
Ms sultan ece altınok çalışkan	Türkiye
Mr Şener Çintesun	Türkiye
Dr Nuray Çiçek	Türkiye
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WG4 – Knowledge sharing and stakeholders' engagement

Members (96)

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Mr Shader Alizade	Azerbaijan
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Dr Demet Altındal	Türkiye
Prof Henrik Per Aronsson	Sweden
Dr Murat Balaban	Türkiye
Prof Faheem Shehzad Baloch	Türkiye
Prof Edward Barrett-Lennard	Australia
Mr Richard Bellis	Netherlands
Dr Alon Ben-Gal	Israel
Prof ali volkan bilgili	Türkiye
Prof USTUNER BIRBEN	Türkiye
Dr Bas Bruning	Netherlands
Dr Alessandro Campanaro	Italy
Dr Antonella Castagna	Italy
Prof Artemi Cerda	Spain
Dr Tanmay Chaturvedi	Denmark
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Ms Zenepe Dafku	Albania
Dr Gökhan DEGE	Türkiye
Prof Turgay Dindaroglu	Türkiye
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Dr Lucia Ferrone	Italy
Prof Vasileios Fotopoulos	Cyprus
Dr Elson Ian Nyl Galang	Canada
Ms Colette Gerards	Netherlands

Dr Karen Ghazaryan	Armenia
Mr Andrés Parra González	Netherlands
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Mr Filippo Grassi	Italy
Prof Pınar Gültekin	Türkiye
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Prof Mirza Hasanuzzaman	Bangladesh
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Prof Abdelaziz Hirich	Morocco
Dr Muhammad Imran	Netherlands
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Dr Tuba Karabacak	Türkiye
Dr Maria-Anastasia Karatzia	Greece
Dr Anthony Kaziboni	South Africa
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Mr Muhammad Tahir Khan	Lithuania
Dr Ruhangiz Mammadova	Azerbaijan
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Dr Hesam Mousavi	Norway
Dr Mohammad Mukarram	Uruguay
Dr Tuncay Narin	Türkiye
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Dr Eda Orhun	Bulgaria
Mr Kushagra Pandey	Netherlands
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Mr Miguel Salazar	Portugal
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Prof Guluzar Duygu Semiz	Türkiye
Dr Sinethemba Sidloyi	South Africa
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Dr Arjen de Vos	Netherlands
Dr Ioana Vrabiescu	Netherlands
Prof Tugrul Yakupoglu	Türkiye
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WG5 – Policy framework for the salinisation management

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Prof Anna Andreetta	Italy
Dr Muhammad Ayaz	Lithuania
Prof Faheem Shehzad Baloch	Türkiye
Dr Jorge Batlle-Sales	Spain
Dr Selim Bayraktar	Türkiye
Prof USTUNER BIRBEN	Türkiye
Prof Artemi Cerda	Spain
Dr Usman Khalid Chaudhry	Türkiye
Prof Turgay Dindaroglu	Türkiye
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Prof Ahmed El-Hussein Elnewishy	Egypt
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Dr Fatma Kaplan	Türkiye
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Dr Leena Karrasch	Germany
Dr Anthony Kaziboni	South Africa
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Mr Muhammad Kamran Khan	Poland
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Prof Vítor João Pereira Domingues Martinho	Portugal
Dr Primitiva Mboyerwa	Tanzania
Dr Milos Milosevic	Serbia
Prof Goran Mladenovic	Serbia
Dr Abdelmohssin EL MOKADDEM	Morocco
Mr Muhammad Mudasir	Czechia
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Prof Guluzar Duygu Semiz	Türkiye
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Ms Janina Smaoui	Netherlands
Ms Judit Snethlage	Netherlands
Prof Serghei Sprincean	Moldova
Dr Enise SUKUŞU	Türkiye
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Mr Isaak Trajkovic	Serbia
Prof Vesna Tunguz	Bosnia & Herzegovina
Prof Pier Vellinga	Netherlands
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WG6 – Network communication and dissemination of results

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Dr NÜKET ALTINDAL	Türkiye
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Ms KONSTANTINA MARIA APOSTOLOU	Greece
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Dr Marco Dainelli	Italy
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Mr Mehmet Murat Dogusan	Türkiye
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Prof Ahmed El-Hussein Elnewishy	Egypt
Dr Erhan Erdel	Türkiye
Prof Nurinisa ESENBUĞA	Türkiye
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Prof Faten Gorsane	Tunisia
Mr Filippo Grassi	Italy
Prof Fabio Gresta	Italy
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Prof Karim Ben Hamed	Tunisia
Mr Muhammad Anwar Ul Haq	Italy
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Dr Ziya İnce	Türkiye
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Dr Fatma Kaplan	Türkiye
Dr Tuba Karabacak	Türkiye
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Dr Mehmet Emin KENANOĞLU	Türkiye
Mr Muhammad Kamran Khan	Poland
Mr Muhammad Tahir Khan	Lithuania
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Dr Ana Marques	Portugal
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Dr Mohamed El Mazlouzi	France
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Prof Goran Mladenovic	Serbia
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Dr Sahar Pouya	Türkiye

Dr Sima Pouya	Türkiye
Dr Manuel Pulido	Spain
Dr Muhammad Qaswar	Belgium
Dr Hafeez Ur Rahim	Italy
Dr Filippo Randelli	Italy
Dr Milica Rat	Serbia
Dr Rosa M Rivero	Spain
Dr Maria Rodrigues	Portugal
Dr Süreyya Betül RUFAİOĞLU	Türkiye
Mr Joaquim Santos	Portugal
Prof Muhammad Saqib	Pakistan
Dr Serdar SARI	Türkiye
Prof TEMEL SARIYILDIZ	Türkiye
Dr Sumesh Sasidharan	France
Ms Catharien Terwisscha van Scheltinga	Netherlands
Ms Helga Fanni Schubert	Hungary
Prof Guluzar Duygu Semiz	Türkiye
Mr Mingze Shi	Ireland
Prof Vojislav SIMONOVIC	Serbia
Dr Abhishek Singh	Armenia
Ms Judit Snethlage	Netherlands
Dr Aymen SOUID	Italy
Dr Astghik Sukiasyan	Armenia
Dr Dilek Tekdal	Türkiye
Mr Pim van Tongeren	Netherlands
Mr Isaak Trajkovic	Serbia
Dr Dogan Turkyilmaz	Türkiye
Dr Ulku Dagdelen Turkyilmaz	Türkiye
Prof Vasileios Tzanakakis	Greece
Prof Oscar Vicente	Spain
Dr Nieves Vidal	Spain
Mr Domenico Villano	Italy
Dr Ioana Vrabiescu	Netherlands
Ms Aimal Waheed	Lithuania
Dr Adnane EL Yaacoubi	Morocco
Dr AYTÜL YILDIRIM	Türkiye
Prof Cengiz Yücedağ	Türkiye
Prof Ivan Zlatanovic	Serbia
Dr Nuray Çiçek	Türkiye