



International Union of Soil Sciences®

# **International Forum of IUSS Inter-Congress 2024**

## **Abstract**

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# Soil biodiversity and One Health

*Prof. Yongguan Zhu, Research Center for Eco-environmental Sciences,  
Chinese Academy of Sciences, Beijing, China*

## **Abstract**

Soil is among the most biodiverse habitats on Earth, it has been estimated that around 60% of species live in soil, at least part of their lives. Soil biodiversity plays a critical role in nutrient cycling, accumulation of soil organic matters, soil-borne disease control and plant health, thus is essential for sustainable crop production. Nonetheless, the role of soil biodiversity is well beyond crop production. In recent years, the concept of “One Health” has been widely adopted to address the connectedness of human, animals, plants and the entire ecosystem, and soil is the bridge in linking all these components at the ecosystem level, both locally and globally. In this, talk I will discuss how harnessing the soil biodiversity will contribute to the co-health of all lives-*i.e.* “One Health”. I will also provide perspectives on future soil biodiversity research under the framework of “One Health”.

## **Profile**

Professor Yongguan (Yong-Guan) Zhu, Academician of the Chinese Academy of Sciences (CAS), Fellow of *TWAS* (The World Academy of Sciences), Fellow of International Science Council (*ISC*), professor of environmental science and health, is the Director General of the Research Center for Eco-environmental Sciences, CAS. He has been working on environmental health and wellbeing related to pollution, soil biodiversity and microbial ecology. He obtained his PhD from Imperial College, London in 1998. He was a scientific committee member for *ISC* program on Human Health and Wellbeing in Changing Urban Environment, and is a member of the Committee of Science Planning of *ISC*. He served for nine years as a member of Standing Advisory Group for Nuclear Application, International Atomic Energy Agency (2004-2012). He

has received many merit awards, including TWAS Award for Agricultural Science 2013, National Natural Science Award 2009 & 2023, International Union of Soil Science *von Liebig* Award 2022. He publishes widely in international journals with an *H*-index of 126 (Web of Science), and has been selected as a Web of Science *Highly Cited Researcher* (2016-2024).

# **Multiple concurrent environmental factors affecting soils and terrestrial ecosystems**

*Prof. Matthias Rillig, Freie Universität Berlin, Germany*

## **Abstract**

Even though it is clear that multiple factors of human-caused global environmental change are simultaneously impacting ecosystems, the overwhelming majority of experimental work addresses the effects of just one or two such factors. Work on up to ten factors jointly acting on plant and soil has shown that the sheer number of factors has effects. Similar effects of the number of factors are also apparent from global observational studies. Documenting such patterns is important, as this may uncover the true nature and extent of environmental issues. At the same time, high dimensional approaches may also hold the key for possible solutions. For example, will we need to counter the high-dimensionality of environmental impacts with matching restoration efforts that also incorporate a large number of concurrent management activities?

## **Profile**

Matthias Rillig is a professor of ecology at Freie Universität Berlin, Germany. Matthias is a member of the German National Academy of Sciences and the Academia Europaea – the Academy of Europe. Since 2017 he has been a Highly Cited Researcher. His team currently works on a range of topics, including on the effects of global change factors on soils and their biodiversity. Much of the research focuses on fungi, including saprobic fungi and mycorrhiza.

# **Towards Sustainable Use and Management of Soil, Sediment, and Water Resources**

*Prof. Frederic Coulon, Cranfield University, England*

## **Abstract**

Soil and sediment pollution, often resulting from anthropogenic activities, frequently extends beyond localized areas (point-source pollution) to cover extensive regions (diffuse pollution), sometimes crossing national borders. These resources are essential for providing food, drinking water, energy, and materials for infrastructure. They also play a crucial role in addressing climate change, non-renewable resource depletion, and environmental justice. However, these finite resources face increasing pressures and conflicts over their use, leading to the overconsumption of natural capital. The conventional "business as usual" approach is no longer viable, necessitating urgent, smart land use and soil management strategies to balance the supply of natural capital and ecosystem services with societal demands.

This presentation will explore the evolution of environmentally responsible business models since the 1980s, highlighting the shift towards integrating financial, environmental, and social responsibilities. We will discuss the concept of sustainable development and the "Three Pillars of Sustainability"—economic, environmental, and social goals. Emphasis will be placed on nature-based solutions for contaminated land remediation and brownfield redevelopment in urban areas, addressing holistic soil, sediment, and water systems management, and enhancing climate resilience. Additionally, the presentation will cover the role of digital technologies, particularly Geographic Information Systems (GIS), in transforming resource management. GIS technology integrates hardware, software, and data to capture, manage, analyze, and display geographically referenced information, aiding in visualization, trend analysis, and decision-making. We will explore

the benefits of smart, real-time monitoring and decision-making at measurement locations, including improved data quality, consistency, and remote configuration capabilities.

### **Profile**

Professor Frederic Coulon holds a Chair in Environmental Chemistry and Microbiology at Cranfield University and is internationally renowned for his contributions to pollution control and remediation in the contaminated land, waste, and wastewater sectors. As the Director of the UKRI Engineering Biology Hub's Environmental Biotechnology Innovation Centre (EBIC), he focuses on engineering biological applications and environmental biotechnology for remediation. He is also the Chairman of Aquaconsoil and the NICOLE Academic Group. Professor Coulon has significantly influenced policy development and waste disposal strategies through his risk-based solutions for managing contaminated environments in UK, Europe and China.

# **The Water, Climate, Soil and Food Nexus: Impacts On Sustainability And Society**

*Prof. Donald L. Sparks, University of Delaware, USA*

## **Abstract**

Land degradation, water quality and quantity, air quality, climate change, soil contamination, and food security are foremost issues of our time. We must be at the forefront in addressing and providing solutions to these vexing challenges that threaten humankind. It is also incumbent that we tackle the research needs in an interdisciplinary manner by forging collaborations with natural scientists, social scientists, engineers, and humanists. We must also communicate the results and solutions in a meaningful way to decision makers and the public. This presentation will focus on the impacts of a changing climate on coastal resiliency, soil and water contamination, air quality, cycling of nutrients, food production, and national security. Opportunities will be presented on how to address some of these complex challenges.

## **Profile**

DONALD L. SPARKS is the Unidel S. Hallock du Pont Chair and Francis Alison Professor at the University of Delaware. He is internationally recognized for his research in the areas of kinetics of biogeochemical processes and surface chemistry of natural materials. His research has focused on fate and transport of trace metals in soil and water, soil remediation, water quality, and carbon sequestration in soils. He is the author of three textbooks, 12 edited books, and 370 refereed papers and book chapters. Dr. Sparks is a fellow of five scientific societies, and he has been the recipient of major awards and lectureships including the Geochemistry Medal from the American Chemical Society, the Liebig Medal from the International Union of Soil



Sciences, Pioneer in Clay Science award from the Clay Minerals Society, an Einstein Professorship from the Chinese Academy of Sciences and the Philippe Duchaufour Medal from the European Geosciences Union. Dr. Sparks served as president of the Soil Science Society of America and the International Union of Soil Sciences and as chair of the U.S. National Academy of Sciences (NAS) Committee for Soil Sciences.

## **Boosting the Practice of Sustainable Soil Management**

*Dr. Yuxin Tong, Global Soil Partnership, Land and Water Division, FAO,  
Italy*

### **Abstract**

Soil is a critical resource, essential for food production and ecosystem services such as water regulation, climate stabilization, biodiversity conservation, and carbon sequestration. Despite its significance, soil has historically been mismanaged and perceived as an infinite resource, leading to its degradation. Currently, approximately 33% of global soil is degraded due to population pressures, increased food demands, and competing land uses. Addressing this, multiple stakeholders are incorporating sustainable development goals to ensure the sustainable use of soils.

In response, and its Global Soil Partnership (GSP) was established by Food and Agricultural Organization of the United Nation (FAO) and member countries in 2012, creating a collaborative platform for stakeholders, from land users to policymakers, to enhance soil governance and sustainable management. The GSP fills a critical gap by promoting policies and practices that prioritize soil health and sustainability. It has successfully elevated global awareness and provided a forum to discuss and address soil-related challenges.

Key action priorities of GSP include developing inclusive soil policies, promoting investments in sustainable soil management, fostering targeted soil research, and enhancing education on soil conservation. Additionally, the GSP emphasizes minimizing further soil degradation, restoring degraded soils, stabilizing soil organic matter, and improving global fertilizer use efficiency. Another vital initiative is strengthening soil information systems to monitor

and manage soil health effectively. These actions aim to secure the future of soil resources while addressing the vulnerabilities faced by people dependent on them.

### **Profile**

Yuxin Tong, work at the Global Soil Partnership, Land and Water Division, FAO. He supervises the activities of the International Network of Black Soil (INBS), the International Network on Soil Fertility and Fertilizers (INSFOILFER) and the Global Soil Laboratory Network (GLOSOLAN). He also involved in the implementation of the International Code of Conduct for the Sustainable Use and Management of Fertilizers, and implemented South-South Cooperation projects on capacity building of soil fertility in Africa as leading technical officer. Before joining FAO, his research was focused on the sustainable management of black soils, balanced fertilization, soil erosion and acidification.

# **Soil Moisture the Integrative Mater Variable in Terrestrial Ecosystems**

*Prof. Gene Kelly, Colorado State University, USA*

## **Profile**

Gene Kelly is a Professor of Pedology and Director of the Colorado Agricultural Experiment Station at Colorado State University (CSU). He received his B.S. and M.S. degrees from Colorado State University and his Ph.D. from the University of California-Berkeley. Dr. Kelly conducts research and lectures nationally and internationally on various aspects of soils as related to global change issues. His scientific specialization is in Pedology and Geochemistry with primary interests in regional soil water dynamics, soil degradation, and global biogeochemical cycles. His current research is centered on soil degradation, soil water dynamics, and regenerative agriculture. He is the chair of the U.S. National Committee for Soil Science with National Academy of Sciences. He serves as an advisor to the United States Department of Agriculture with the National Cooperative Soil Survey, USDA's National Institute of Food and Agriculture, The National Science Foundation, Forum for Agricultural Research in Africa, and several major research programs. He is a Fellow of the Soil Science Society of America and is a recipient of the Soil Science Society of America Research Award.

# **Managing soil and crops to benefit human nutrition and health**

*Prof. Fang-Jie Zhao, Nanjing Agricultural University, China*

## **Abstract**

Soil is the foundation of human nutrition. Soil, through plants and animals, provides most of the nutrients required by humans. Yet, a quarter of the global population suffer from 'hidden hunger' caused by a deficiency of mineral micronutrients or vitamins in their diets. Seven mineral nutrients (iron, zinc, copper, calcium, magnesium, selenium, and iodine) and several vitamins are often lacking in human diets. Hidden hunger is caused by over-reliance on staple cereals and lack of diet diversity, as well as poor nutrient status in soil and crops. Crop breeding has successfully improved the yields of major cereal crops around the world. Yet, mineral nutrient concentrations of these cereal crops have declined due to higher yields resulting in nutrient dilution, narrower crop genetics, and/or soil nutrient depletion. Future climate change is predicted to increase the risk of hidden hunger. At the same time, soil contamination is increasing globally due to human activities and poor environmental protection. Toxic metals and metalloids such as cadmium and arsenic accumulate in soil and can be transferred to the food chain, posing a significant risk to human health. Recent progress in understanding how soil management, fertilization and crop breeding can be employed to increase the contents of essential micronutrients and minimize the accumulation of toxic metals/metalloids for the benefit of human nutrition and health will be discussed.

## **Profile**

Fang-Jie Zhao is a Professor of Environmental Science at Nanjing Agricultural University, China. He received his PhD at Newcastle University, U.K. Prior to

taking up the current position in China, he worked at Rothamsted Research, U.K. for over 20 years. His research focuses on the biogeochemistry of essential trace elements and toxic metals/metalloids in soil-plant systems, molecular mechanisms of trace element uptake by plants, biofortification of essential micronutrients and bioremediation of contaminated soils. He has co-authored two books and published over 400 peer-reviewed journal papers. He is a Highly Cited Researcher by Clarivate Analytics (2017 – 2023). He is the recipient of The World Academy of Sciences (TWAS) Award in Agricultural Science and the International Fertilizer Association's Norman Borlaug Plant Nutrition award in 2022.

# **Green and Sustainable Remediation of Contaminated Soil at Brownfield Sites**

*Prof. Deyi Hou, Tsinghua University, China*

## **Abstract**

This presentation will give an overview of green and sustainable remediation of contaminated soil and groundwater at brownfield sites, and its linkage with the United Nations' Sustainable Development Goals. The author will discuss sustainable remediation of contaminated soil and groundwater from various aspects: life cycle thinking, primary, secondary, and tertiary impacts, sustainability in brownfield remediation, and adoption of GSR globally and in China.

## **Profile**

Prof. Deyi Hou is the Director of Soil and Groundwater Division at Tsinghua University. He is also serving as the Vice Chair of the UN-FAO International Network of Soil Pollution (INSOP). Prof. Hou obtained his BS from Tsinghua University, MS from Stanford University, and PhD from University of Cambridge. His research has focused on contaminant transport and distribution in soil and groundwater, synthesis of innovative environmental functional materials, green and sustainable remediation. He also had over 10 years of industrial experience in the US and the UK in the field of soil and groundwater remediation (2006-2015). Prof. Hou has conducted numerous projects involving soil and groundwater pollution at site-level, regional-level, and national level. He has published 5 books and over 200 journal papers on top journals including *Nature*, *Science*, *Nature Climate Change*, *Nature Sustainability*, *Nature Review Earth & Environment*, etc. Prof. Deyi Hou is currently serving as the Editor-in-Chief for *Soil Use and Management* (flagship journal of British Society of Soil Science), and Associate Editor for

*Science of the Total Environment.*