Soil and Water Ecological Insights from the Australia Investigation and the International Conference on Healing Riverscapes

Fazheng SUN[1]*, Chengyan HUANG[2], Rong HU[2]

1. Soil and Water Ecology Professional Committee of Guangdong Provincial Ecological Society, Shenzhen 518131, China; 2. Shenzhen Nature Ecological Garden Technology Co., Ltd., Shenzhen 518131, China

Abstract From June 23 to 27, 2025, the 11th Ecosystem Services Partnership World Conference (ESP11) was held at the Darwin Convention Centre in Australia, with the theme of "From global to local ecosystem services: pathways to Nature-based Solutions inspired from Down Under". As the founder of the theory of soil and water ecology, the author was invited to attend the conference and delivered an English academic report at the B2—Healing riverscapes venue. Before and after the conference (June 19 – July 5, 2025), the author also conducted soil and water ecological investigations in various locations such as Australia's Great Ocean Road, Penguin Island, Kiama Blowhole, and Kakadu National Park. The insights from the Australia investigation regarding soil and water ecology are: ① preserving the native soil and water ecology; ② protecting the culture of soil and water ecology; ③ achieving both ecological and economic benefits. The soil and water ecological insights from the International Conference on Healing Riverscapes include: ① advocating for near-natural engineering methods; ② integrating river healing techniques, methods, and philosophies with community needs; ③ emphasizing flood mitigation and disaster resilience; ④ valuing the cultural heritage of indigenous peoples in protecting the soil and water ecosystem; and ⑤ maintaining the health of river ecosystems. Theory and practice demonstrate that the theory of soil and water ecology is a theoretical distillation of Nature-based Solutions (NbS), serving as a common theoretical foundation in the field of ecological environment and possessing universal significance globally.

Key words ESP11 World Conference; Nature-based Solutions (NbS); Theory of soil and water ecology; Healing riverscapes

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The world today is facing ecological and environmental crises such as climate change, biodiversity loss, environmental pollution, and unsustainability, which pose severe challenges to human survival and development. There is an urgent need to construct a systematic and global ecological governance plan and theoretical framework. The ESP11 world conference, held at the Darwin Convention Centre in Australia from June 23 to 27, 2025, gathered experts and scholars from around the world in the field of ecology. With a focus on Nature-based Solutions (NbS), the conference delved into in-depth discussions on practical pathways for ecosystem services, providing an important academic exchange platform for global ecological governance. At the same time, it also offered an effective way to disseminate theories related to soil and water ecology.

As the founder of the theory of soil and water ecology, the author was invited to participate in this world conference and delivered an English academic report at the B2—Healing riverscapes: Promoting Nature-based Solutions for Conserving/Restoring Rivers session, systematically disseminating the theory of soil and water ecology. Before and after the conference (June 19 – July 5, 2025), the author also conducted soil and water ecological investigation in various places in Australia, such as the Great Ocean Road, Penguin Island, Kiama Blowhole, and Kakadu National Park. In this paper, the academic exchange outcomes at the B2—Healing Riverscapes venue were briefly introduced. Combining the field investigations in Australia, the understanding of the global universal significance of the theory of soil and water ecology was deepened, providing beneficial insights for the ecological environment field in China and even globally.

1 Core content of the ESP11 world conference and the international dissemination of the theory of soil and water ecology

1.1 Overview of the conference and topics discussed at the venue Healing Riverscapes On the morning of June 23, 2025, the ESP11 world conference opened at the Darwin Convention Centre in Australia, with the theme of "From global to local ecosystem services: pathways to Nature-based Solutions inspired from Down Under". The president of the Darwin University in Australia and the head of the Darwin City Government delivered speeches respectively, while the local aboriginal art troupe presented a cultural performance. This was the second time for the author to attend the ESP World Conference.

At the venue of B2—Healing Riverscapes at the ESP11 world conference, experts and scholars from various global institutions, including the Copperbelt University, Zambia, the Lithuanian Or-

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* Corresponding author.

nithological Society, the Hungarian Research Network – Centre for Ecological Research, the NRM Regions Australia, Jagun Alliance Aboriginal Corporation, the Wildlife Institute of India, and National Taiwan University, China, conducted report exchanges. Scholars from diverse geographical backgrounds shared their experiences in restoring river ecosystems under different social contexts, and emphasized the importance of explicitly incorporating NbS into national policy frameworks and decision-making processes. NbS represents a paradigm shift in river restoration. Leveraging the power of natural processes, it creates resilient ecosystems that benefit both nature and society. The principles, methods, and case studies of NbS in river restoration were explored, highlighting the effectiveness of NbS in addressing contemporary ecological and environmental challenges. Sustainable strategies for river restoration were developed, and the resilience of ecosystems was enhanced by utilizing natural processes.

The shared achievements included: restoring the connectivity of river ecosystems through near-natural methods, such as removing obstacles in rivers and restoring key indicator species. Balancing the needs of communities in water resource management and disaster prevention, and establishing harmony between social and ecological goals; restoring and managing bird breeding grounds or habitats that are of great significance to the European Union. By protecting, sustainably managing, and restoring ecosystems, it ensured suitable habitat conditions for rare birds in inland waters and remote, complex-managed rural wetlands. It explored the latest advancements in integrating microalgal communities for monitoring heavy metal pollution in aquatic ecosystems. It discussed the application of diatoms alone or in combination with other indicator organisms (such as invertebrates, aquatic plants, and fish), as well as the integration of physicochemical methods in aquatic ecosystem monitoring. River restoration has become a key strategy for providing biodiversity benefits, while bringing multiple co-benefits to communities, including enhancing disaster resilience through flood mitigation. Case studies and lessons learned in the field of ecological restoration management in Australia involved the practice and effectiveness of river restoration on biodiversity and disaster resilience, including qualitative and quantitative results from a series of case studies. River landscapes are important systems for both ecology and culture, which have been increasingly subject to human interference and impacts, including land degradation, overuse of water resources, and the intensifying effects of climate change. Caring for country is a holistic and interconnected framework rooted in the knowledge system and responsibility of Australian indigenous peoples. In the context of river landscapes, the activities it encompasses include cultural burning, restoration of riverbank vegetation, seasonal waterway monitoring, and protection of sacred sites. Rivers should not be regarded as inanimate resources, but rather as "living sovereign entities" that require care, respect, and a sense of responsibility.

1.2 International dissemination of the theory of soil and water ecology The author delivered an academic presentation titled "Protection, Restoration, and Utilization of Soil and Water Ecology under the Background of New Quality Productivity" at the ESP11 World Conference. In the report, a scientific question was first raised: "what is the common theoretical foundation in the field of ecological environment?". And a scientific assertion was made: "on the Earth, wherever there is soil and water, there must be vegetation growth; and the growth of vegetation preserves the soil and water ecological resources". Next, the scientific elaboration on the protection, restoration, and utilization of the Earth's soil and water ecology was presented in five parts. The report concluded by stating: "the theory of soil and water ecology is a theoretical distillation of 'NbS', representing a systematic and academic exploration of the scientific assertion that 'lucid waters and lush mountains are invaluable assets'. It serves as a common theoretical foundation in the field of ecological environment, and lays the core framework for the establishment of the *Soil and Water Ecology*".

This was the author attending the ESP World Congress for the second time. The 2017 ESP9 World Congress was held at the Qilin Mountain Villa in Shenzhen, China. The author's work *Ode to Soil and Water Ecology* was presented at the conference, to promote the theory of soil and water ecology. Through various forms of communication and interaction, such as the official APP, on-site discussions, and exhibition board displays, the current ESP11 world conference provided an effective way to disseminate the theory of soil and water ecology on an international academic platform, further expanding the international influence of the theory of soil and water ecology and gaining widespread attention and recognition from peers in the global ecological field.

2 Investigation of Australian soil and water ecology, as well as natural and cultural landscapes

Surrounded by the sea on all sides, Australia boasts a land area of approximately 7.69 million km^2 and a population of just 26.9 million (as of July 2024). 95% of its land remains uninhabited. As the only country in the world covering an entire continent, Australia's unique geographical and demographic features have nurtured a rich and intact native ecosystem of soil and water.

2.1 Twelve Apostles Rocks: natural preservation of the indigenous coastal soil and water ecology On June 29, 2025, the author traveled approximately 400 km by special vehicle to visit the geological wonder of the Twelve Apostles Rocks in the Pacific Ocean (the cover of the high school English textbook published by People's Education Press), passing through pastures and forests, and observing koalas. On the return journey, the author took the Great Ocean Road the entire way. The wind blowing from the Antarctic Circle stirred up tumultuous waves on the coast, and occasionally, a double rainbow would rise high into the sky over the distant ocean. On the other side of the highway, they were greeted by a panorama of pristine mountains or wetlands. The natural scenery is picturesque, and it is hailed as one of the most beautiful

coastal highways in the world. The Twelve Apostles Rocks stand majestically along the Pacific coast, boasting a history of 20 million years. Formed by the long-term erosion of limestone by sea waves, their number and shape resemble those of the Twelve Apostles in the biblical story, hence they are named after them. The 200-plus km of coastline along the Great Ocean Road have always maintained their original state in terms of soil and water ecology, without artificial intervention in greening. The natural geological features and the integrity of the soil and water ecosystem have been fully protected.

2.2 Penguin Island: protection and utilization of soil and water ecology of the native beach On the evening of June 30, 2025, the author observed penguins returning to their nests at Summerland Beach on Phillip Island (also known as Penguin Island) in Melbourne. As early as a thousand years ago, penguins began nesting and roosting among the weeds in this barren sandy land, developing a stable habit of leaving early and returning late, following a fixed route, and returning to their nests at dusk or nightfall. To protect the penguin habitat, it strictly preserves the original landform and vegetation in the area. It is equipped with only a single lane, and there are no artificial drainage ditches, greening facilities, or other such structures, in order to minimize disturbance and damage to the original soil and water ecology. Meanwhile, with a focus on protection, the nature reserve limits the annual number of visitors to no more than 500 000 people. The annual ticket revenue alone can reach hundreds of millions of yuan, while the cost is very low. It achieves a virtuous balance among ecological, economic, and social benefits, and is a successful case of realizing the value of soil and water ecological products.

2.3 Kiama Blowhole: protection of the original soil and water ecology of geological heritage On July 4, 2025, the author took a special vehicle to visit the Kiama Blowhole in Kiama, New South Wales. The rock structure of this landscape was formed during the Permian period approximately 260 million years ago, gradually shaped by long-term erosion of seawater through the rock's interconnected fractures. When sea waves rush into the crevice, due to the drastic change in air pressure, a spectacular water column up to 6 – 20 m high is formed. Under the sunshine, it complements the rainbow, creating a unique and rare natural landscape. The scenic area maintains its original soil and water ecology, without artificial intervention in arbor greening, and retains naturally growing wild herbaceous vegetation. The coastal native soil and water ecology, along with the peculiar basalt landscape, have been well preserved, reflecting the "minimal intervention" concept of soil and water ecology protection.

2.4 Kakadu National Park: preservation and inheritance of soil and water ecological culture During the inspection period, the author also visited Kakadu National Park, which preserves ancient cave dwellings and mural and stone carvings dating back 20 000 years. Both the pristine natural environment and cultural heritage are well-protected. The mural and stone carvings clearly record the production and living scenes of ancient humans as well as their ecological cognition, which, together with the intact surrounding native soil and water ecosystem, constitute a unique "ecological-cultural" landscape. On the native wetland stretching for thousands of kilometers, lush green grass, aged trees, flocks of birds, and wandering crocodiles present a scene of vitality.

3 Core connotation and global universal significance of the theory of soil and water ecology

3.1 Definition of soil and water ecology[1] Soil and water ecology refers to the ecological balance relationship in which the three major elements of water, soil, and vegetation on the Earth are interdependent, mutually constrained, and mutually reinforcing. Broadly speaking, soil and water ecology encompasses all the relationships among water, soil, and vegetation during their movement and evolution, including various ecosystems and natural forms on the Earth such as glaciers, deserts, salt lakes, forests, and wetlands. It is a core component of the Earth's ecosystem.

3.2 Core viewpoint of the theory of soil and water ecology

3.2.1 Soil and water ecology is the backbone of the ecosystem. Water, soil, and vegetation, as the three fundamental elements constituting all ecosystems, form an organic whole: vegetation, as the primary producer, is the source of energy circulation in the ecosystem; soil and water, as the dominant elements of the environmental system, provide the material basis for the survival and development of organisms. The three interact and co-evolve, jointly maintaining biodiversity and the stability of ecosystem functions.

3.2.2 Soil and water ecology is the "greatest common divisor" of various ecosystems[2]. The theory of soil and water ecology distills the common characteristics of different types of ecosystems on the Earth, reveals the basic natural laws governing the operation of soil and water ecology, and is universally applicable to the protection and management practices of various ecosystems worldwide.

3.2.3 Human interference is the root cause of ecological and environmental issues. Global ecological crises such as climate change, biodiversity loss, and environmental pollution essentially stem from the destruction of the soil and water ecological balance by human activities. This understanding provides a theoretical basis for accurately identifying the causes of ecological problems and formulating scientific governance plans.

3.3 Global and universal significance of the theory of soil and water ecology The theory of soil and water ecology reveals the universal laws governing the operation of various ecosystems globally. It is a theoretical distillation of NbS, providing a unified theoretical foundation for the field of ecological environment and possessing global guiding value. Its universal significance is reflected in two aspects: on the one hand, the essence of integrated protection and management of mountains, rivers, forests, fields, lakes, grasslands, and deserts lies in the protection and management of soil and water ecology. All kinds of ecological protection and restoration projects must be carried out in accordance with the laws of soil and water ecology to achieve sustainable and stable

ecosystems. On the other hand, this theory is a theoretical and systematic exploration of the scientific assertion that "lucid waters and lush mountains are invaluable assets". It provides theoretical support for the realization of the value of ecological products and the coordinated development of ecology and economy, and lays a solid foundation for the establishment of the discipline of *Soil and Water Ecology*[3].

4 Revelations from the Australia investigation and the international conference on healing riverscapes

4.1 Insights from the field investigation on soil and water ecology in Australia

4.1.1 Protecting the original soil and water ecology. In the areas such as the Great Ocean Road, Penguin Island, and Kiama Blowhole in Australia, they all adhere to the principle of "minimal intervention", without large-scale artificial greening or engineering construction, thus avoiding damage to the original landform, vegetation, and ecosystem. This fully demonstrates that maintaining the natural attributes of the soil and water ecosystem is the key to sustaining biodiversity.

4.1.2 Attaching importance to the inheritance of water and soil ecological culture[4]. In Kakadu National Park, the protection of ancient human remains dating back 20 000 years is organically combined with the protection of the native soil and water ecosystem, achieving a coordinated inheritance of the soil and water ecosystem and cultural heritage, and providing a useful reference for the protection of soil and water ecological culture.

4.1.3 A win-win situation for both ecology and economy[5]. In Penguin Island, it ensures ecological safety by strictly limiting the number of visitors, and moderately develops eco-tourism with the core of native soil and water ecological landscape. It achieves high efficiency with low cost, and the management model of "protection priority, moderate utilization" provides a practical paradigm for the realization of the value of global soil and water ecological products.

4.2 Inspiration from the international conference on healing riverscapes

4.2.1 Advocating near-natural construction methods[6]. Ecological restoration of rivers should fully align with the natural attributes of rivers and the needs of biodiversity. The focus should be on enhancing the self-restoration capacity of the ecosystem through near-natural methods such as restoring key indicator species and removing anthropogenic barriers, to avoid excessive human intervention that could lead to the degradation of ecosystem functions.

4.2.2 Integrating with community needs. River management needs to balance the dual goals of ecological protection and community development, accommodate the reasonable demands of communities in water resource utilization and disaster prevention, establish a harmonious relationship between ecological and social objectives, and enhance the social acceptance and sustainability of management plans.

4.2.3 Enhancing the level of disaster resilience construction. River ecosystem restoration should focus on enhancing functions such as flood mitigation and soil and water conservation. By constructing a healthy and stable river ecosystem, it can strengthen regional disaster resistance and achieve synergistic enhancement between ecological protection and social security.

4.2.4 Inheriting the ecological wisdom of indigenous people. The holistic ecological framework of Australian indigenous' "Caring for country" and their reverence and sense of responsibility towards natural entities such as rivers provide a unique cultural perspective for modern ecological governance. Therefore, it should attach importance to the exploration, inheritance, and integrated application of traditional ecological knowledge.

4.2.5 Establishing the concept of ecosystem sovereignty. Rivers are not lifeless resource carriers, but "living sovereign entities" that require human care, respect, and responsibility. This concept restructures the cognitive relationship between humans and nature, providing important value guidance for soil and water ecological protection.

5 Conclusions

Through academic exchanges and experience sharing in the global ecological field, the ESP11 world conference verified the significant value of NbS in global ecological governance. It provided an effective method of NbS for cross-border and cross-regional ecological collaborative governance, and also offered an effective way for the global dissemination of the theory of soil and water ecology. The field investigation in Australia has revealed a clear thread of ecological protection of native soil and water, cultural inheritance of soil and water ecology, and coordinated development of ecological economy. It provides a vivid case for the global dissemination and application of the theory of soil and water ecology, and also offers important insights for the integrated protection and management of mountains, rivers, forests, fields, lakes, grasslands, and deserts in China.

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