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## **PROJECT TITLE**

**Soil-Water Interactions and Cyanobacterial Metabolites: From Ecosystem Health to Bioactive Compound Discovery**

## **Project description (max 300 words)**

Soil and water are intrinsically interconnected, and soil health, including its organic matter and microbial communities, plays a crucial role in influencing water quality and maintaining the balance of aquatic ecosystems<sup>1</sup>. Nutrient enrichment of rivers, lakes, and coastal waters due to anthropogenic activities such as agriculture, industrial processes, and wastewater discharge, as well as climate change, are key drivers of microbial and microorganisms proliferation, with significant consequences for water quality and safety<sup>2</sup>.

Among these microorganisms, cyanobacteria, photosynthetic prokaryotes inhabiting both terrestrial and aquatic environments, play a fundamental role in aquatic ecosystems. As primary producers, they generate energy, organic matter, and essential nutrients that support higher trophic levels<sup>3</sup>. However, certain cyanobacterial species can produce cyanotoxins and other bioactive metabolites, which may contaminate drinking water sources and pose serious risks to both human and animal health<sup>4</sup>. This dual nature makes their presence a critical factor in the safe management of drinking water supplies<sup>5</sup>.

Interestingly, some cyanobacterial metabolites, known as cyanometabolites, have shown potential for beneficial applications in food supplements, cosmetics, and even medicine<sup>6</sup>.

Against this background, the Ph.D. project will be multidisciplinary focusing on the investigation of soil properties and biocrust characteristics near water bodies such as reservoirs, lakes, and ponds used for potable or recreational purposes and their possible correlation. Samples will be collected in Europe and non-European countries also considering the impact of different environmental conditions, land use and anthropogenic stresses. The research will include the study on possible mitigation strategies using LC-HRMS-based metabolomic approaches. In addition, chemical profiling of cyanobacterial strains, carried out in collaboration with partners from Bologna, Switzerland, Brazil, Turkey, Algeria, and Spain. The study will involve a diverse collection of strains, and the bio-guided fractionation of crude extracts to isolate, structurally characterize novel bioactive compounds and discovering possible new applications.

## REFERENCES

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