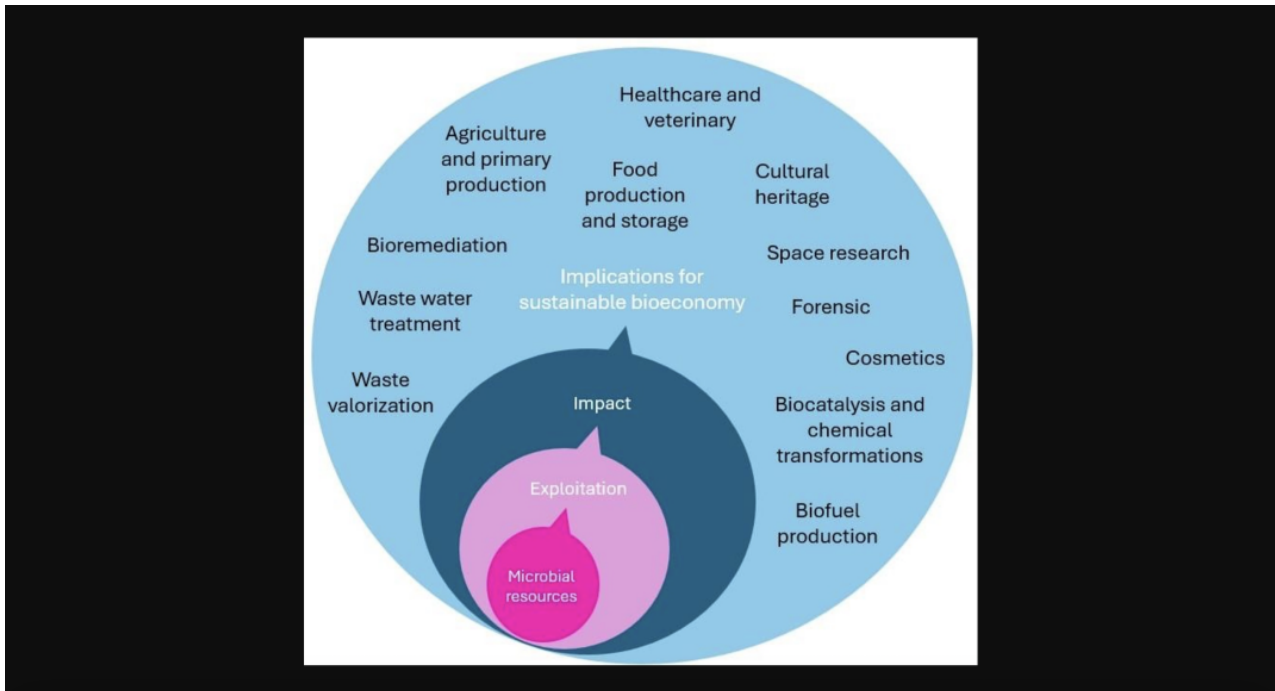


SUS-MIRRI.IT: How microbial culture collections hold up a more sustainable, competitive, and resilient bioeconomy

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Graphic representation of outcomes derived from the application of microbes.

Marino Moretti and Giovanna Cristina Varese, Project Manager and Scientific Coordinator, respectively, of the EU-funded project SUS-MIRRI.IT, on behalf of all project partners, explain how safeguarding microbial biodiversity is extremely paramount for the future of our planet

Microbial Culture Collections (mCCs) are repositories of microorganisms, and recently of microbiomes (i.e., communities of microorganisms such as bacteria, yeasts, filamentous fungi, and viruses that share the same habitat along with their theatre of activity), which investigate and safeguard microbial biodiversity. These institutions facilitate access to microbial resources to the scientific and industrial communities and provide information on the data associated with them, as well as expertise in microbiology, services, training, and knowledge transfer in the healthcare, agro-food, and environmental domains.

Why is it so important to maintain microbial biodiversity?

Microorganisms are the predominant life forms on our planet. Currently, about 2.3 million species of microorganisms have been named, which represent less than 10% of the estimated microbial diversity (although projections reach even trillions of species).

Microbial communities are ubiquitous in the biosphere and pivotal for the functioning of ecosystems through the regulation of biogeochemical cycles and the production and absorption of greenhouse gases. Furthermore, they play essential roles in maintaining soil structure and fertility, improving soil and plant health, and fostering the quality and productivity of seas, lakes, and rivers. They also cover the surfaces of all other organisms and colonize the gastrointestinal and reproductive tracts of humans and animals, influencing their physiology and fitness.

An impoverishment in microbial biodiversity might have catastrophic consequences for the whole planet. Despite all this, microbial biodiversity is often neglected when analyzing the adverse effects of the destruction of natural habitats. This is one of the main reasons for preserving and protecting microorganisms and microbiomes in mCCs.

Nowadays, microbial biodiversity is considered a valuable resource with implications for economics, finance, and society. Microorganisms and microbiomes are currently exploited in many biotechnological applications that support humanity's progress daily. Microbial resources can be considered the engine of bioeconomy and environmental sustainability to promote global development and human wellbeing. However, to reach this outcome, it is necessary to integrate and replace many of the current practices and technologies with biotechnological processes. Tackling global challenges such as climate change and achieving the UN Sustainable Development Goals requires consideration of the exploitation of microorganisms and microbiomes.

For which sectors can the activity of a mCC be useful?

Microorganisms are increasingly used in agriculture (biocontrol of pests and biofertilization as a sustainable alternative to agrochemicals), environment (wastewater treatment, bioremediation of polluted sites, waste valorization), food making (starter cultures for fermentation processes), chemistry (bio-catalysis in industrial processes), cultural heritage (bio-restoration of artworks), nutrition and healthcare (probiotics, new foods and feeds, drugs, and diagnostics), biofuel production, cosmetics, and even in forensic and space research.

Could you briefly tell us a bit about your project and explain why, for the bioeconomy, this can be of interest to the whole society?

The project 'Strengthening the MIRRI Italian Research Infrastructure for Sustainable Bioscience and Bioeconomy' (SUS-MIRRI.IT), which has been funded by the program NextGenerationEU, was launched in 2022, with a budget of about €17mn. ⁽¹⁾ The project is coordinated by the University of Torino (Italy) and includes 24 partners from other Italian Universities and public Research Centres. The aim of SUS-MIRRI.It is to implement the management and offers provided by Italian mCCs, making the most of microbial genomic and metabolic potentials useful for biotechnological and industrial purposes.

Italian mCCs boast a great richness of microbial resources that can be exploited to obtain benefits for a model of a green, competitive, and resilient bioeconomy.

The project aims to enhance the bioresources preserved in the Italian Microbial Culture Collections (mCCs). This enhancement includes an increase in the number of preserved strains and the development of skills, quality certification, and possible methods for value realization. Additionally, a digital platform for handling and sharing FAIR (Findable, Accessible, Interoperable, and Reusable) microbial data will be released, and state-of-the-art technologies will be employed to enhance facilities and platforms.

The restyling of Italian mCCs through the SUS-MIRRI.IT project is set to be a flagship initiative. It aims to foster partnerships with industries and stakeholders, facilitate the transfer of know-how, attract capital, and increase collaborations with public authorities. This will give mCCs a stronger voice in decision-making processes related to environmental, healthcare, and agricultural policies. Additionally, the project will explore new frontiers in science, such as utilizing microbiomes to promote a clean environment, enhance food security, and improve human health. Overall, SUS-MIRRI.IT will bolster scientific development and innovation, leading to positive economic outcomes. These significant effects have the potential to guide society towards a more sustainable future for our planet.



Logo of the Italian division of MIRRI, the pan- European Research Infrastructure that deals with the conservation, characterization, and distribution worldwide of microbial resources with an excellent certified standard of quality

Why can Italian microbial CCs make a difference?

Italy has a rich microbial biodiversity with many unique species, making it valuable not only for the food and beverage industry but also for other important fields. Italy's microbial culture collections contain around 100,000 microorganisms.⁽²⁾ It's important to note the richness and uniqueness of the preserved microbial genetic diversity, as well as Italy's expertise in specific categories of microorganisms, such as microalgae and plant viruses, which are not well-represented in collections outside of Italy. Additionally, the preservation of various microbial communities from different sources will allow the creation of a biobank archive repository of microbiomes.

The Italian microbial Culture Collections opening up to the European and international community through the European Research Infrastructure MIRRI (Microbial Resource Research Infrastructure) will provide significant benefits to the European Research Area (ERA) and the global research community.

So, in the end, microbial CCs can be considered pillars of our planet's economy.

Besides the preservation and distribution of microbial resources and the provision of services, expertise, and advanced training in the domain of microbiology, mCCs act as promoters of technological and scientific innovation. These Institutions foster investments in the research field, encourage the aggregation and the exchange of skills and resources (including human capital), stimulate the transfer of knowledge and know-how, endorse policymakers in taking decisions and initiatives for future strategic planning, push competitiveness among the international scientific and business communities, so they nourish the development of a circular economy inspired by an environmental-friendly and sustainable vision.

References

1. <https://www.sus-mirri.it/>
2. <https://www.mdpi.com/2071-1050/16/9/3777>

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