

Report on the development of datasets and benchmarking data

1. Introduction

The development of datasets and benchmarking data was a central activity within COST Action PRIORITY (CA20101), directly supporting Deliverable 10: “Report on the development of datasets and benchmarking data”. These efforts primarily focused on systematically mapping the European research landscape and harmonizing analytical methodologies through structured surveys and pre-tests.

The main outcomes contributing to this deliverable can be grouped into two major dataset initiatives and one practical benchmarking exercise:

- Geospatial Mapping of EU-Funded Research
- Interlaboratory Studies (ILS) Survey and Benchmarking Data

2. Geospatial Mapping of EU-Funded Research Projects

A structured database and geographical mapping effort was undertaken via a Virtual Mobility (VM) grant during September–October 2023 to provide an open overview of the Micro- and Nanoplastics (MNP) research landscape. This activity was coordinated within WG6 (Metrology and Standardization).

2.1 Dataset Development and Scope

- **Data Collection:** The process began with a data assessment of ongoing and closed research projects funded by EU programs within the CORDIS database. Over 552 projects were manually screened using search terms such as “microplastics,” “nanoplastics,” and “plastics”.
- **Participant Engagement:** To avoid overlooking projects and enhance participation, a virtual survey was circulated to PRIORITY participants, resulting in 166 responses which were screened and added to the initial database.
- **Final Dataset:** The resulting dataset was structured into a coherent geospatial database, available publicly as a .csv file and .shp file. It includes geolocations (latitude, longitude) for all project partners, keywords defining the research field and area, and links to project webpages.

- **Benchmarking and Visualization:** The work successfully created map products and an interactive geographical map, covering 280 institutions worldwide active in MNP-related research. These graphic products offer a quick overview of the European MNP research network, showing the temporal development of projects, partner distribution by research field, and research hotspots in Europe.

2.2 Limitations and Follow-up

The current VM output is limited to projects funded by EU programs, excluding projects funded nationally within the EU. Future activities planned include enhancing the database with industry-funded projects through an additional survey in collaboration with PlasticEurope.

3. Interlaboratory Studies (ILS) Survey and Benchmarking Data

A second major dataset was developed through a systematic survey (ILS Survey) focused on mapping interlaboratory studies related to MNP research, conducted via a VM grant in September–October 2024. This initiative was critical for supporting standardization efforts by WG6.

3.1 Survey Methodology and Participation

- **Objective:** The survey aimed to gather information on past, ongoing, and planned ILS, focusing on matrices, polymer types, analytical techniques, and difficulties encountered.
- **Reach:** The survey was shared with all PRIORITY members (around 500) and representatives from National Metrology Institutes and standardization bodies. It collected 128 answers from participants across 50 countries, including European members (especially Italy, Spain, Serbia, Portugal) and non-European participants (Australia, Mexico, Canada, Israel, and Nigeria).
- **Benchmarking Finding:** Only 50 participants out of 128 (39%) declared involvement in any ILS.

3.2 Key Benchmarking Data from ILS Activities

The comprehensive report created from the survey consolidated information on both official (metrology-led) and informal (research-driven) ILS.

- **Matrices Studied:** More than 80% of reported ILS focused on microplastics identification in water. Sediments and soils were also frequently included, while air was the most neglected matrix, despite increasing interest in ongoing studies. Biological samples were assessed in 38% of previous studies.

- **Polymers and Materials:** The most frequently studied polymers were PET, PS, PE, and PP. For future ILS, many participants expressed interest in analyzing aged versions of polymers to increase environmental relevance.
- **Techniques Compared:** Spectroscopic techniques (especially FTIR and Raman) were the preferred and most compared methods, often coupled with morphological screening. Pyrolysis-GC-MS and light scattering methods were used by fewer participants.
- **Major Difficulties Encountered (Benchmarking Challenges):** Participants identified sample preparation (e.g., aggregation, particle loss, filtration challenges) and data analysis (e.g., complex interpretation of degraded spectra, unreliable automated software) as primary challenges. Contamination, particularly from airborne fibers, was noted as a significant and potentially underestimated problem.
- **Size Focus:** Most analyzed ILS focused on specific size ranges in the micrometer range (e.g., 50 μm to 500 μm), but greater attention is fixed on small microplastics (below 100 μm), and few ongoing studies focus on nanoplastics.

3.3 Impact and Follow-up

The ILS survey results contributed to the creation of datasets and benchmarking data (Deliverable 10). This dataset will form the scientific foundation for a joint perspective paper with the PlasticTrace project, focusing on the design, statistical evaluation, and reporting of ILS from both metrological and research viewpoints.

4. Hands-on Benchmarking: The "Water Kettle Comparison Study"

WG3 (Instrumentation, Modelling, Data Evaluation, and Analytical Procedures) and WG6 jointly coordinated a pre-test exercise, known as the "Water Kettle Comparison Study," to benchmark analytical methods under no-budget conditions.

- **Objective:** The goal was to assess the release of microplastics during water boiling processes and to compare the results obtained using various complementary analytical methods.
- **Key Benchmarking Findings:** The exercise revealed that a large proportion of the generated particles were smaller than 20 μm , challenging the detection limits of certain analytical techniques. As a result, reported particle counts and size distributions varied across participating methods due to differences in lower size thresholds and data evaluation settings.

- **Strategic Conclusion:** Based on these methodological questions, WG6 concluded that future interlaboratory studies should rely on simpler and more controlled test materials, such as microplastic suspensions of defined size and known polymer composition, to test identification accuracy and reproducibility. It was determined that the most effective strategy was to collaborate with and support existing ILC initiatives coordinated by metrological institutes rather than organizing new ILCs internally within PRIORITY.

These activities, coupled with the systematic review of extraction methods in MNP analysis, provided substantial scientific evidence that can serve as direct inputs for future standardization and harmonization guidelines.

5. Conclusions

These extensive data gathering and benchmarking activities, ranging from mapping global research involvement to identifying the critical limitations of current analytical techniques (especially for particles below 20 μm), serve as the GPS coordinates for future MNP standardization, clearly indicating where scientific efforts are clustered and where critical methodological gaps remain.