Currently, plastic production is estimated at 350 million tons and will exceed one billion tons by 2050. Their massive use translates into increasing amounts of micro- and nanoplastics (MNPs) in the environment. Micro- and nanoplastics are defined as particles 5 mm - 100 nm and <100 nm and are generated by the weathering of macroplastics or are intentionally produced as micro- or nanoparticles. In addition, they are formed during littering, abrasion, irrigation, mulching, and the use of compost and sewage sludge in agriculture. According to preliminary estimates, 63 000 - 430 000 tons of MNPs enter European agricultural fields every year. Despite literature reports indicating mobility of MNPs, the possibility of its accumulation in the soil environment should be taken into account. The presence of MNPs will directly shape the multi-level interactions between all components of the soil environment. The most relevant factors are presented below, indicating the need for insightful analysis of these factors.

The presence of MNPs in soil has a very strong effect on water retention capacity (expressed as: permanent wilting point (PWP), field capacity (FC), and saturation (SAT)), as demonstrated in experiments with plants. MNPs ensured water availability while filling some of the pores with air for longer periods of time, which translates into rapid biological processes under aerobic conditions. However, excess water translates into slow anaerobic processes and, on a macro scale, dying of plant roots. An equally important factor is the effect of MNPs on water transfer between macro- and micropores present in soil aggregates. **There is a lack of research showing how changes in the amount and availability of water generated by the presence of MNPs affect the rate of degradation of selected xenobiotics in the soil environment, as well as the quantitative and qualitative composition of soil microbial populations.**

Another, perhaps even more important factor is the sorption capacity of MNPs. The humic and fulvic acids present in the soil act analogously as a sponge that sorbs xenobiotics entering the soil. Through sorption, humic and fulvic acids reduce the concentration of xenobiotics available at any given time, resulting in actual reduction in the bioavailability and toxicity of a given xenobiotic to microorganisms. MNPs in soil will significantly affect the functioning of humic and fulvic acids. MNPs like humic and fulvic acids show very good sorption properties. Not surprisingly, the reduction of toxicity of selected xenobiotics in soil in the presence of MNPs has been reported in the literature. **There is a lack of research showing how the increase in soil sorption capacity due to the presence of MNPs will affect the degradation rate of selected xenobiotics in the soil environment, and consequently also the quantitative and qualitative composition of the soil microbial population.**

Moreover, there is a lack of research that comprehensively addresses the multilevel relationships between the presence of MNPs in soil and the amount and availability of water and sorption of xenobiotics in terms of the rate of biodegradation processes and changes in microbial populations.

The novelty of our project is the idea to estimate the real impact of MNPs on the functioning of soil environment by means of analysis of degradation rates of model xenobiotics, which are herbicides, surfactants, antibiotics and hydrocarbons present in agricultural soil. For this purpose, we will dissect the complex soil system and determine separately the changes in water availability and sorption processes on humic and fulvic acids, in terms of changes in the dynamics of xenobiotic degradation, as well as population changes of microbial communities. The research will start with a simple soil (artificial - sand) and then move on to real more complex agricultural soils. In addition, to mimic the natural processes we will also introduce plants. The final step will be to analyze the accumulation of xenobiotic and its metabolites on humic and fulvic acids, MNPs, biomass, plants which will allow us to estimate the rate of accumulation of organic matter in soil, and indirectly to estimate the changes generated by MNPs in the carbon cycle. Through the research planned in this project, we will verify the real impact of MNPs on environmental xenobiotic mineralization processes.

The real gain of our project will be published data on the effect of MNPs on the degradation of model xenobiotics in the soil environment. We will provide scientists with an ideal reference material to facilitate the interpretation of their own research. Currently, there are no scientific reports that so comprehensively analyze the role of MNP in the functioning of the soil environment.