Landfilling of municipal waste in Poland has been one of the dominant methods of its disposal for many recent decades. Until recently, municipal waste in Poland could be stored without treatment. In the process of adjusting the Polish law to the EU legislation, municipal waste is currently subject to mandatory mechanical and biological pretreatment technologies (MBT), ensuring stabilization of the waste before sending it to landfills. Landfilling entails generation of leachate. The major contributing factor is the infiltration of rainwater through a landfill. It leads to the leaching of a wide range of pollution. These include various substances, as well as microorganisms, including pathogens. It is very important to manage the leachate from landfills in a way that is safe for the environment. A solution, quite popular in Poland, is to treat leachate together with municipal wastewater in municipal wastewater treatment plants (WWTPs).

Municipal waste landfills are a reservoir of huge and diverse populations of microorganisms, also present in leachate. Particularly dangerous are the bacteria which own resistance to antimicrobial substances used in the treatment of humans and animals. The main cause of bacterial insensitivity to antibiotics, resulting from having one or more antibiotic resistance genes (ARGs), is the mishandling of medicines. Unused or expired antibiotics should be disposed of safely, but in practice they are often mixed with other waste and stored on landfills, as a result of which their presence is then detected in landfill leachate. Wastewater delivered to WWTPs is found to contain antimicrobial substances too, which are finally released to the environment, most often in an unchanged form. It has been shown that the release of antimicrobial substances to the environment and the presence of ARGs are mutually related.

Both MBT installations and WWTPs belong to environments creating optimal conditions for the exchange of genetic structures, including ARGs, among microorganisms. Because of that, treatment of landfill leachate together with wastewater can lead to the emergence of an additional threat to aquatic environments, because treated wastewater is discharged to surface water. To the best of our knowledge, the research results published so far do not provide data on the co-treatment of landfill leachate from MBT installations with municipal wastewater.

The main idea of this project will be to determine relationships between the presence of landfill leachate originating from MBT installations in wastewater delivered to WWTPs and the spread of drug resistance in the environment. The planned investigations will allow us to evaluate the impact of simultaneous treatment of leachate and wastewater on the presence and abundance of ARGs at subsequent steps of treatment. Also, the project envisages studies into the effect of seasonality on the presence of ARGs.

For this project, it was selected two WWTPs, situated in the same region of Poland, use coincident technologies of treatment, and receive a similar type of wastewater. However, a significant difference between the two facilities lies in the fact that only one receives landfill leachate from an MBT installation. The choice of the two WWTPs allows us to consider one of these objects as a control one, while the other is the subject of our research, and this approach will enable us to assess the actual impact of the co-treatment of landfill leachate with municipal wastewater on the environment, in the context of the dissemination of ARGs. Both landfill leachate and municipal wastewater with and without landfill leachate will be analyzed. Wastewater samples will be collected at three different stages of treatment, both in the test and control WWTPs. In addition, the project also assumes the collection of river water in the section before and after exposure to effluent discharged from selected WWTPs facilities in order to assess the impact of co-treatment of landfill leachate with municipal sewage on the environment. All samples will be taken in each of the four seasons.

The studies planned to be performed under this project can be considered as pioneering ones because of the broad scope of interest they cover. The research proposed in this project, which will be based on both physicochemical and molecular analyses, including qPCR and metagenomic sequencing, will provide a wide range of data, both chemical and biological ones. The investigations planned in the submitted project will fill the existing gap from the point of view of threat to the environment and will make a valuable contribution to the discussed issue.