Project *brief*

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Microplastics in the environment: Investigations in the Warnow catchment

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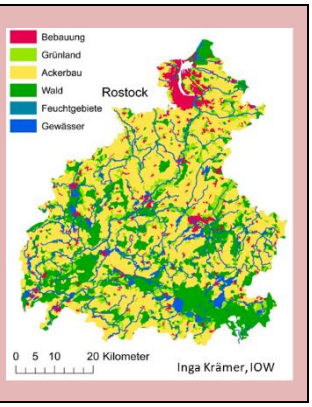
- **As part of the collaborative project MicroCatch_Balt, we estimated the spatial distribution of microplastic inputs from the potentially most important sources in agriculture in a small, rural river basin**
- **Through the parallel investigation of two river basins (Warnow and Weser) in cooperation with the PLAWES project, the influence of the different land use structures was considered**
- **The results point to strong regional variability with local microplastic concentrations, which should be considered in more detail in subsequent studies**
- **Such an overall view is indispensable in order to assess the scope for policymaking and to develop efficient options for action**

The study area:
The Warnow catchment area (approx. 3,320 km²) is predominantly rural, with the exception of the Rostock city area in the estuary. Arable land and grassland predominate on light soils; strawberries and asparagus are cultivated sporadically.



Background and objective

In the public discussion on the topic of microplastics in soils, agriculture is increasingly attributed a significant role. As the largest user of land and due to the highly visible cultivation with plastic cover and mulch film as well as the use of plastic films in silage production, agriculture is often seen as a relevant emitter of microplastics into the soil. However, it is also a victim because, according to the current state of knowledge, 81 % of emissions occur outside agriculture and farms recycle contaminated compost and sewage sludge as a service in the sense of the circular economy.

Microplastics are ubiquitous in the environment and have also been detected in soils with no known agricultural pollution history. The significance of microplastic sources associated with agriculture cannot be quantified with certainty at present. The most commonly discussed sources are contaminated sewage sludge, polluted compost, and the application of agricultural films.

From 2017 to 2021, we investigated the topic of microplastics in agriculture as part of the joint project MicroCatch_Balt, which was funded by the BMBF as part of the FONA program "Plastics in the Environment". The aim of the project was to improve the understanding of the overall system of microplastic sources, transport pathways, and fate in the environment. The Warnow river basin and the estuary into the Baltic Sea served as a small, predominantly homogeneous and rural study area. At the same time, we were involved in the partner project PLAWES, which investigated the catchment area of the Weser and the coastal area of the North Sea under the same objective.

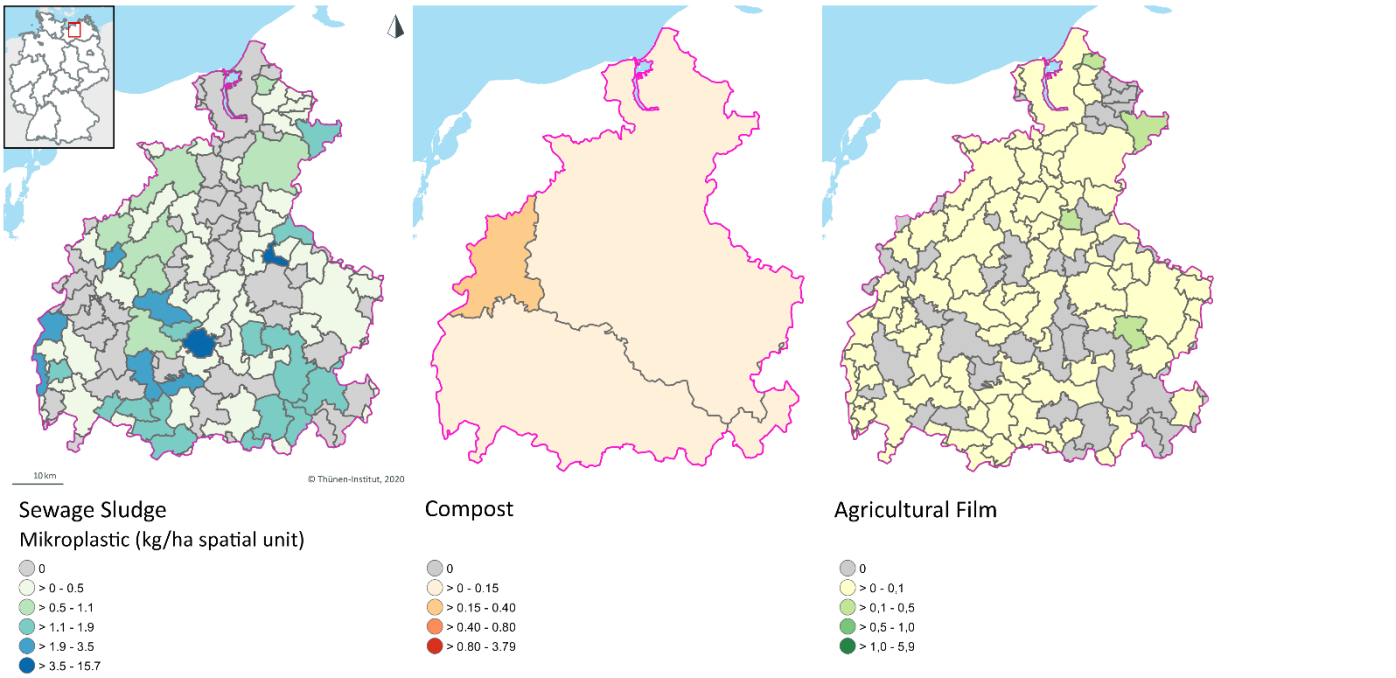
Approach

In this joint project, special attention was paid to microplastic inputs from sewage sludge and compost application. To this end, we adapted the RAUMIS model to the microplastic question in order to estimate the spatial distribution on agricultural land. For this purpose, we multiplied spatially explicit statistical data of application and production quantities with the respective emission factors of the two sources and scaled them according to the total quantities for each year in the period under consideration in order to obtain total inputs over the period from 1983 (sewage sludge) and 1990 (compost) to 2016. In the partner project PLAWES, the focus was on the development of the agricultural film input model.

Results

According to our initial estimates, a total of 213 Mg of microplastics were introduced into agricultural soils in the Warnow catchment area from 1960 to 2016 through sewage sludge, 52 Mg through compost and 7 Mg through mulch and

Spatial distribution of modelled cumulative microplastic inputs from sewage sludge, compost and agricultural films from 1960-2016 in agricultural soils, shown in kg per hectare of the spatial unit (=polygon area).



Source: own calculation.

cover films. Especially in the case of sewage sludge, the spatial variability of the inputs is very high. In comparison, the results of the catchment areas of the Warnow and the Weser show clear differences. In the rural Warnow catchment, the stronger influence of sewage sludge stands out, while compost and films are more important in the Weser catchment. Sewage sludge is increasingly applied in the Warnow catchment due to the light, sandy soils and is partly imported from other federal states. Film-intensive special crops play only a minor role.

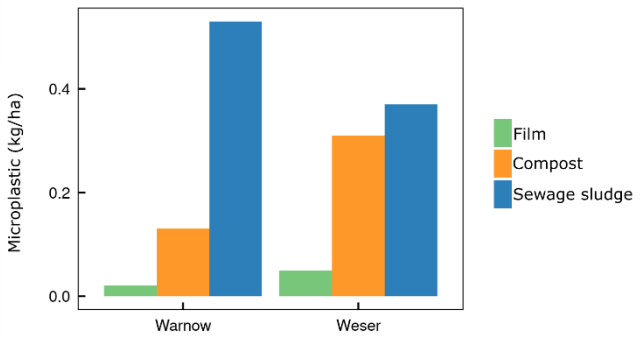
Recommendations

The clear spatial variability suggests that regional agricultural structures have a considerable influence on the distribution of pollution hotspots and should be taken into account in the development of monitoring projects. Although the best available data basis was used, the results are partly based on a still thin data basis.

The model can be easily adapted through improved input data. The focus on the agricultural input sources considered here should also be extended to the overall picture of possible emissions in order to better classify the relevance of agricultural options for action.

In Germany and Europe, the first monitoring programmes have been launched to record the microplastic content of soils under different uses. However, due to the methodological challenges and the high amount of work involved, analysis will only be able to provide selective results in the long term. Models are needed to improve the system understanding of microplastic sources, pathways and fate in the environment. This factual basis can be used to identify possible mitigation measures and to test their efficiency and boundary conditions.

Mean modelled cumulative microplastic inputs from 1960 to 2016 in the catchments of the Warnow (MicroCatch_Balt) and Weser (PLAWES).



Source: own calculation.

Further information

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Publications

Brandes E, Henseler H, Kreins P (2021) Identifying hot-spots for microplastic contamination in agricultural soils - a spatial modelling approach for Germany. *Environ. Res. Lett.* 16 (2021) 104041 DOI:10.1088/1748-9326/ac21e6

Brandes E, Cieplik S, Fiener P, Henseler M, Herrmann F, Klasmeier J et al. (2020): Modellbasierte Forschung zu Mikroplastik in der Umwelt. https://bmbf-plastik.de/de/publikation/modellbasierte-forschung-zu-mikroplastik-der-umwelt

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