SUMMARY OF DOCTORAL DISSERTATION

entitled

A methodical approach to modelling of resource flows in the context of their regionalisation, based on the example of selected municipal waste streams

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The dissertation addresses the issue of optimising the flow of resources in geographical space using the chosen municipal waste stream as an example. The aim of the work was to determine the variation in the total cost of the entire waste management system, the unit costs incurred by waste emitters, and the distribution of flows depending on the components adopted in the modelling. To this end, certain research assumptions were made, which limited the wide range of variables affecting transport costs to selected groups of components most commonly used in studies of various types of flows and spatial availability in the literature on the subject.

The research area covered the entire territory of Poland, while the basic analytical unit was the municipality. Due to the fact that municipal waste was the selected resource (the selected fraction was mixed waste), a method for modelling input data (waste mass) was developed in order to eliminate statistical errors identified in the primary data. Thus, an important part of the work is the description of the methods and procedures for modelling data for the purposes of the study and the characteristics of the distribution of mixed waste in the projections adopted for 2021 and 2030. The study consisted of organising the values of flows in the O/D (Origin-Destination) matrix in such a way as to minimise the total cost. Depending on the method used, it was possible to obtain different interrelations, which affected the variation in total cost and unit costs.

The study was divided into component groups. The first group consists of the issue of the impact of the transport network on mixed waste flows. Both the type of network and its spatial distribution were taken into account, comparing the results for three different distance measures – orthodromic lines, roads and travel time. The second group consists of components affecting waste supply. The study examined how socio-demographic changes affect waste flows according to four supply scenarios. The third component was related to

legal and administrative conditions and referred to the level of system disintegration (the creation of independent regional subsystems) and the market power structure, where the decision-making function was assigned to issuers or recipients, respectively. The last aspect examined concerned the waste flow modelling method itself. This is the most complex issue and referred to the impact of long-distance travel tolerance, limitations imposed by waste treatment infrastructure (treatment facilities) and the method of calculation. Optimisation models based on the Simplex method were compared with gravity and potential models. The results were synthesised.

The study presented in the dissertation was methodological in nature and served to compare selected approaches to the reorganisation of resource flows in geographical space. The procedures used in this study can be implemented in research on the flow of other types of resources, but this work focuses on municipal waste. The paper therefore refers to the socio-demographic conditions of waste generation and segregation, the usefulness of the presented study in the context of the development of the circular economy and the implementation of the Extended Producer Responsibility (EPR) system.