THE ANALYSIS OF LIQUID MILK SUPPLY TO URBAN AGGLOMERATION BY
BICRITERION LINEAR TRANSPORTATION MODEL WITH THE MPSX/370 PACKAGE

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Abstract
In the paper we formulate a bicriterion linear transportation model to analyse the raw milk supply for an urban agglomeration. The model has been verified for Warsaw. To solve the bicriterion model the lexicographic as well as the parametric methods were used. The model can be considered as an element of a Multicriterial Decision Support System of raw milk supply for Warsaw.

1. Introduction
The rapid growth of the urban population as well as the nutrition value of milk have caused a fast increase in the milk production and consumption. In 1984 the consumption of liquid milk in Polish big cities was on the level of 1.2 milliard litres, that is 46 percent of total amount of liquid milk produced in Poland. The amount of the collected raw milk around large agglomerations lags behind the increase in the consumption of liquid milk in big cities. Warsaw was the best example of this problem. In 1984, the modelled system of milk supply to Warsaw consisted of four stages. The system covered 38 regional milk cooperatives in 9 districts of Poland, which supplied about 210 million litres of raw milk to four city milk plants in Warsaw. The raw milk was transported each day from more than 63 thousand suppliers through almost 18000 permanent milk reception stations. 50 percent of that amount was delivered from the Warsaw District The expansion of the milk transfer area to supply Warsaw resulted in an increase of the transportation radius as well as in higher transportation costs.

The forecast of the Central Union of Dairy Cooperatives determines that in 1990 raw milk collected around Warsaw will cover 20.7 percent of total amount of milk consumption. Till the 2 000, the gap between supply and demand for the raw milk will be much deeper. It also have an influence on the energy consumption, because the dairy industry is one of the most energy intensive industries between food
industries in Poland.

The aim of the paper is to show the possibilities of the liquid milk supply to Warsaw by the optimization methods. This analysis have been achieved by a bicriterion linear transportation model. To predict the future possible transfer area of supplying Warsaw for 1990 we have made ex-post analysis for the period of 1984-1986. The model was solved by lexicographic as well as by parametric methods. The bicriterion analysis was performed with MPSX/370 package, which is regarded as a standard commercial tool to solve linear programming problems.

2. The statement of the model

The model of the milk marketing system for urban agglomeration is presented on Fig. 1. One of the main functions of this system is transportation of goods from the producers to the final customers. This transportation process consists of the following homogenous three parts /see: [2] :

1. the collection of milk as a raw material or semiproducts to the milk processing plants,
2. the transportation of milk as a raw material or semiproducts between milk processing plants and city milk plants,
3. the distribution of liquid milk or liquid and solid milk products from the city milk plants to the retailing customers.

Elements of total physical milk marketing system for Warsaw