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PROBLEMS WITH THE LOGISTICS OF SUPPLYING DAIRY PLANTS WITH MILK

*PROBLEMY LOGISTYKI ZAOPATRZENIA ZAKŁADÓW MLECZARSKICH
W SUROWIEC MLECZNY*

Key words: logistics, supply, dairy cooperative, milk, dairy farm, transport

Słowa kluczowe: logistyka, zaopatrzenie, zakład mleczarski, mleko, gospodarstwo mleczne, transport

JEL codes: Q12, Q13, L10

Abstract. The article aims to identify problems with the logistics of supplying dairy plants with milk. The methods used in the article include an analysis of literature and diagnostic surveys. Focused interviews were conducted with chairmen of cooperatives and directors for purchase and transport of milk in six dairy plants in various parts of Poland. Based on the research conducted, the following problem areas related to the logistics of supplying dairy plants with milk were identified: the number and size of the suppliers, seasonal character of milk production, continuous collection of milk, the suppliers' location and problems with the organisation of transport.

Introduction

Milk production is an important branch of agricultural production in Poland and in the world. In 2016, Poland was the fourth milk producer in the European Union (EU) and Polish farmers produced over 8% of European milk [Eurostat 2016]. Polish plants also obtain a high income from the sale of dairy produce. Since the political and economic transformation, considerable changes have taken place in the dairy industry sector resulting mainly from Poland's accession to the EU. On the one hand, EU membership have enabled dairy plants to enter the common European market and, on the other hand, exposed them to strong western competition. Milk prices have equalised, which have exerted pressure on the improvement of competitiveness at the stage of milk processing [Pietrzak et al. 2010]. Logistics may turn out to be a significant area of improvement to ensure competitiveness. Logistics may be defined as an integrated system of management, organisation and supervision of processes connected with the physical flow of products (resources, materials and products) and their informative conditions in the context of optimisation of tasks fulfilled [Blaik 2010].

In a dairy plant, we can distinguish logistics of supply, which is the subject matter of the article, and logistics of distribution, which together create a logistic system of a company. Logistics of supply in dairy plants aim to ensure all possible material needs of a company at the lowest logistic costs. It concerns availability of resources, materials and products maintaining a plant in production readiness [Wojciechowski 1999].

The main raw material for the production of dairy plants' range of products is milk, which is supplied by farmers breeding dairy cattle. The method of collecting, storing and transporting milk is an important element influencing the quality of raw milk. Raw milk is characterised by very low insensitivity to transport and storing, requires everyday production and must often be supplied for processing, which influences the logistics of supply to a large extent.

Material and research methodology

The article aims to identify problems connected with the logistics of supplying dairy plants. The methods used in the article to fulfil the aims include an analysis of literature and diagnostic surveys. The analysis of literature includes a critical review of literature on the logistics of supply, the logistics of dairy plants and the transport of milk.

Within diagnostic surveys, focused interviews were conducted with chairmen of cooperatives and directors for purchase and transport of milk in six selected dairy plants in various parts of Poland (marked with numbers 1 to 6) in order to determine organisational and transport links between each plant and the suppliers of raw milk. They were conducted in autumn 2015. The interviews covered the following issues: organisation of milk transport, means of transport, milk transport routes, cooperation with middlemen in the field of milk transport, a milk transport radius, the suppliers' characteristic features and the size of milk purchase. The analysis also covered the suppliers of milk to the examined cooperatives (the research covered 5,709 dairy farms in total, which constitutes 4.4% of all wholesale suppliers and 7.4% of wholesale supplies). Dairy plants were deliberately selected for the research. The legal status of a plant was one of the selection criteria. Cooperatives are dominant entities on the milk production market [Pietrzak, Dworniak 2010] and that is why only cooperatives were selected for the research. The location of plants and the area of milk transport in various regions with respect to the development of wholesale milk production, based on the division of communes proposed by Andrzej Parzonko [2013], was another selection criterion.

In order to conduct the analysis of the collected research data, the following groups of quantitative methods were used: methods of statistical description and simulations. The methods of statistical description were used in the analysis of the dairy plants' suppliers and in a comparison of their milk transport routes and elements. The following measures were applied: a minimum, a maximum, an average and a variation coefficient. The second group of methods served the simulation of milk transport routes to dairy plants, based on which the cost of transport for each route and the average cost of transport per 1 litre of milk for each plant were calculated. In order to calculate and compare the cost of transport to all plants, the following formula was used [Roman 2014]:

$$K_{transportu} = K_{zp} + K_w + K_p \quad (1)$$

where: K_{zp} – costs of fuel (average use of fuel during the transport with the use of a given means of transport (in 1/100 km) x the length of the route (in km) x (average price of fuel (in PLN)), K_w – costs of drivers' remuneration (hourly wage (in PLN/hour) x the time of work (in hours)), K_p – other costs, inter alia depreciation, vehicle tax, vehicle insurance, vehicle maintenance etc.

Particular cost component values were adopted based on empiric data of the plants examined. A Microsoft Excel 2013 worksheet and an IT program for optimisation of milk transport costs MuuMap¹ were used to process the research data.

Results

Based on the research conducted, it is necessary to select the following problem areas of the logistics of supply: a big number of dispersed suppliers, seasonal production of milk, a system of continuous collection of milk connected with the short storage life of the material, the form of supply as well as decisions connected with milk transport and information management. Despite numerous structural changes, cattle farms are considerably fragmented in Poland. For example, an average size of a herd in the leading milk producing European countries accounts

¹ The IT system MuuMap ensures complex support to processes and operations in the field of logistics of supplying dairy plants. For more see <http://muumap.pl/pl/>.

Table 1. Descriptive statistics of one-off values of milk supplies to plants

Specification	Dairy cooperatives [l/supply]					
	1	2	3	4	5	6
Number of suppliers	1,469	1,354	762	1,416	302	406
Minimum	30	49	25	detailed data unavailable	63	48
Maximum	18,060	22,652	5,372		10,385	3,135
Average	773	965	752	502	774	657
Coefficient of variation [%]	133	134	92	detailed data unavailable	119	77

Source: results of own research

for circa: 60 cows in Germany, 40 cows in France, 90 cows in the United Kingdom, 150 cows in Denmark [Hamulczuk 2015], and only 8 cows in Poland [GUS 2016]. Moreover, an average Polish farm that is a wholesale supplier keeps 14 cows, i.e. fewer than the leading milk producers in the EU [Pietrzak 2015].

Considerable fragmentation of suppliers is also observed in the dairy plants examined. A one-off supply from one supplier varied from 25 to as much as 18,000 l/supply. On average, it was from 502 to 965 l/supply (tab. 1). Most suppliers found themselves within this scope in every plant and constituted a 22 to 37% share in a plant's milk purchase.

The dispersion of suppliers and the distance between them and a dairy plant have a considerable impact on the efficient planning of milk transport routes. A big dispersion of suppliers and long distance from a plant lengthens the time of milk transport, and thus forces a plant to have a bigger number of means of transport. The supply radius together with the percentage share in the purchased milk in the analysed plants is presented in figure 1. From 54% (plant 1) to 90% (plant 2) of milk was purchased 45 km away from the plant, and from 80% (plant 6) to 100% (plant 2) of milk was purchased 104 km away from the plant.

Figure 1. Percentage share of purchased milk depending on the distance between the suppliers and the plants

Source: results of own research

Seasonal production of milk is another problem area connected with the logistics of supply. A monthly coefficient of variation of milk production in Poland accounted for 5% in 2017. Although it is a small variation throughout a year, the differences between particular months accounted for even ca. 13% [KOWR 2018]. As a result, it constitutes a serious problem for optimal planning of milk transport and efficient use of vehicles, thus planning supplies and production.

Low milk insensitivity to transport and storage constitutes another problem for supplying dairy plants. The material needs continuous collection and maintenance of a stable tempera-

ture at successive stages of supply to ensure protection against pathogens as well as to prevent changes in the smell, taste and texture of milk. As a result, a failure to maintain an appropriate temperature at every stage will result in the decrease of milk quality as well as other dairy produce. The plants examined use a continuous two-day system of milk collection. Unfortunately, the issue eliminates freedom in taking decisions concerning the size of stock.

The problems with the logistics of supplying dairy plants with raw milk may also result directly or indirectly from the organisation of milk transport (fig. 2). Each form has advantages and disadvantages. At present, direct transport of milk from a farm is the most popular method of supplying cooperatives.

Figure 2. Organisation of milk collection and transport to a dairy plant
Source: [Roman 2017]

Milk collection points, formerly very popular, are at present less commonly used. Those traditional forms of purchase still function, e.g. in Podlaskie Voivodeship or Warmian-Masurian Voivodeship. According to Mlekpól, about 1500 suppliers to this cooperative (i.e. 13%) use milk collection points. However, these are small milk producers whose daily production accounts for 30-100 litres of milk [Borawski 2015]. Groups of milk producers or purchase cooperatives or other brokers involved only in the purchase and sale of milk without processing it are relatively new forms of supplying dairy plants with raw milk. Taking into consideration the number of milk producers and the requirements for setting up a group, one can assume that their minimum share in milk purchase on the domestic market accounts for at least 2%. The representatives of the industry estimate that share at 5-8%². The indirect forms of cooperation may result in benefits connected with organisational and transport related aspects of raw milk purchase such as lower costs of transport or the increase in milk collection mileage, which is especially important in case of cooperatives located in regions with insufficient milk supply. On the other hand, the lack of influence on the quality of milk supplied is a disadvantage.

All the above-mentioned problems have a considerable impact on the cost of milk transport and thus influence taking decisions concerning the independent fulfilment of the transport function or outsourcing it, the selection of transport service providers, fleet management and optimisation of transport routes. Table 2 presents descriptive statistics concerning milk transport routes to dairy plants. It should be pointed out that the shortest route accounted for 15 km and the longest one as many as 500 km. At the same time, the average length of routes varied from 62 to almost 216 km. On one route, a driver visited from 1 to 44 farms, which confirms big fragmentation of suppliers. The use of tankers was also inefficient; the amount of milk brought from one route varied from 5.6 thousand to circa 25 thousand litres.

Depending on the size and location of suppliers or forms of purchase, the plants examined incurred different milk transport costs, which varied from 0.01 to 0.04 PLN/l on average; however, maximum costs even reached almost 0.08 PLN/l. It should be emphasised that plants characterised by shorter routes resulting from shorter distances and bigger supplies incurred lower costs of milk transport. As far as the logistics of supply management and planning routes are concerned, IT support is also very important as it facilitates the flow of information between a big number of suppliers and a cooperative, circulation of documents and optimisation of routes.

² The estimate results from the interviews conducted with the selected dairy cooperatives' chairmen.

Table 2. Descriptive statistics of milk collection routes to the dairy plants examined

Specification		Dairy cooperatives					
		1	2	3	4	5	6
Length of route [km]	minimum	15.2	24.0	27.0	42.0	35.5	60.7
	maximum	322.8	212.0	524.0	405.0	418.0	448.2
	average	98.6	61.7	181.5	125.1	162.1	215.9
Number of suppliers on one route	minimum	3.0	1.0	7.0	4.0	2.0	8.0
	maximum	31.0	38.0	27.0	44.0	30.0	28.0
	average	16.8	20.8	17.3	21.5	16.8	17.7
Amount of milk from a route [l]	minimum	6,455.9	10,409.0	8,520.0	5,600.0	8,212.3	6,876.0
	maximum	25,200.0	24,552.0	24,043.0	19,780.0	21,032.5	15,413.0
	average	13,886.6	20,13.9	13,017.2	10,762.3	12,982.0	11,598.0
The cost of transporting 1000 liters of milk [PLN]	minimum	8.2	6.9	14.4	16.3	16.1	22.4
	maximum	47.2	26.7	74.1	78.4	52.9	62.9
	average	20.6	11.5	31.2	32.3	27.5	39.0

Source: results of own research

Conclusions

Dairy plants face many problems connected with the logistics of supply. They have an impact on some of them and, unfortunately, none on others. Factors such as the size of milk production, suppliers' location and seasonality of production may be considered the root problems in the area of supply, which plants cannot influence. They result in successive problems such as frequency of supplies, optimisation of transport and the use of indirect forms of milk collection organisation. At present, the factors are so changeable that it is difficult to limit them without adequate IT programs, thus manage the whole process of the logistics of supply.

In addition, dairy plants should look for cost reductions in every field of logistics: supplies, production and distribution. They should pursue optimisation of entire costs of logistics and not just the costs of particular logistic elements regardless of their consequences for other areas.

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Streszczenie

Celem artykułu jest identyfikacja problemów związanych z logistyką zaopatrzenia zakładów mleczarskich. Wykorzystano metodę studiów literaturowych oraz metodę sondażu diagnostycznego. Wywiad kierowany przeprowadzono z prezesami spółdzielni i dyrektorami ds. transportu/skupu mleka w 6 zakładach mleczarskich zlokalizowanych w różnych częściach Polski. Na podstawie przeprowadzonych badań wyznaczono następujące obszary problemowe logistyki zaopatrzenia zakładów mleczarskich w surowiec mleczny: liczba i wielkość dostawców, sezonowy charakter produkcji mleka, ciągły odbiór mleka, lokalizacja dostawców oraz problemy związane z organizacją transportu.

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