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**AN ANALYSIS OF FARM TRACTORS SALES RESULTS  
IN THE ASPECT OF THE CALENDAR  
OF AGROTECHNICAL OPERATIONS**

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Key words: logistics, distribution systems, farm tractors sales.

**A b s t r a c t**

The article presents problems of logistics of agricultural vehicles distribution. Obtained results of the research on the value and quantity levels of farm tractors sales have been presented. The research was carried out at the Commercial Department of an authorised distributor of farm tractors and agricultural vehicles. The research cycle included the years 2003-2005. The results of the research have been drawn up statistically by indicating the value of seasonal indices. The sales time schedules have been analysed in the aspect of the calendar of agrotechnical procedures.

**ANALIZA WYNIKÓW SPRZEDAŻY CIĄGNIKÓW ROLNICZYCH W ASPEKCIE  
KALENDARZA ZABIEGÓW AGROTECHNICZNYCH**

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Słowa kluczowe: logistyka, systemy dystrybucji, sprzedaż ciągników rolniczych.

**A b s t r a k t**

W artykule przedstawiono zagadnienia logistyki dystrybucji pojazdów rolniczych. Zaprezentowano uzyskane wyniki badań poziomu ilościowego i wartościowego sprzedaży ciągników rolniczych. Badania zrealizowano w dziale handlowym autoryzowanego dystrybutora ciągników i maszyn rolniczych. Cykl badań obejmował lata 2003-2005. Wyniki badań opracowano statystycznie, wyznaczając wartość indeksów sezonowych. Rozkłady czasowe sprzedaży poddano analizie w aspekcie kalendarza zabiegów agrotechnicznych.

## Introduction

The domestic market of farm tractors and agricultural vehicles, due to the globalisation of distribution, is an area of very strong competition of individual economic subjects. Vehicle producers' logistic strategies pay particular attention to the expansion and recruitment of new markets. Poland, as a member of the European Union, is carrying profound restructuring of rural areas along with the investment of financial means in technical equipment of villages. The change of the production technology triggers modernisation of machines, which results in bigger demand for farm tractors and machines. A rich offer of vehicles in a wide scope of functional capacity of engines and additional equipment along with comparable prices cause that promotion and marketing activities are comprehensively supported by logistics.

## Research problem

The basic issue carried out by the sector of logistics in a planned amount of product sales is a selection of distribution channels of appropriate special structure and transport capacity. Organisation of physical distribution on a selected market area should lead to a realisation of customer service at an expected level. Control and corrective actions of the system have an objective to obtain a competitive offer that will ensure an advantage over companies supporting a given market sector. A superior objective of logistic strategy is to ensure the lowest costs for the entire sale chain (CHRISTOPHER, PECK 2005, *Usługi logistyczne*. 2004, *Rynek usług logistycznych*. 2005).

A crucial problem that should be taken into consideration in distribution management is the change ability of demand throughout a calendar year. Disproportion on the level of sales, which is a result of demand seasonally, negatively affects the supply process and may be the cause of a disruption in prompt realisation of orders (COYLE et al. 2002, *Logistyka dystrybucji*. 2005, STOCK, LAMBERT 2001).

The object of the research was the Commercial Department of an authorised distributor of agricultural vehicles. The quantity and value schedule of farm tractor sales was observed during three years of the research. The demand analysis was carried out in the aspect of the calendar of agrotechnical procedures.

## **Distribution logistics of agricultural vehicles**

Companies that sell products and their servicing support constitute the basic model among the companies distributing farm tractors and machines. Benefits that arise from merging logistic subsystems of the distributor with organisational structure of the company stimulate expansion of extensive logistic networks (KEMPNY 2001, *Teoria i praktyka modelowania...* 2004).

Business entities connected with servicing agriculture over the long period of time and having strong position in the market and professional servicing, function as junction points linking logistic systems of a few producers of technical goods. Authorised sale and servicing of farm vehicles and machines of different make by one distributor may be realised under condition that there is no conflict of interest. Such solution functions in the examined company. It sells parallel JOHN DEERE and ZETOR farm vehicles in the area of lubelskie province. An authorised sales representative may also sell at the same time technical goods of various manufacturers, co-operating as a part of one concern. The concern SAME DEUTZ FAHR GROUP may be given as an example of such a solution. The commercial offers of the companies complement each other with vehicles of the Same, Deutz Fahr and Lamborghini makes.

In the situation when two tractors that have the same power units and similar prices are confronted, producers renegotiate with companies the terms of commercial contracts in order to sign new agreements that would guarantee exclusivity for sales of the products of one make. The conflict of interests results from a fight in the market for a potentially the same customer. The mentioned problem occurred during carrying out this research and concerned the tractors sold by the company ZETOR POLSKA and concern SDFG.

### **The sales of farm tractors in the commercial department in years 2003-2005**

During the three-year period of research the services realised by the Commercial Department of the company that is an authorised distributor of the farm tractors and machines of over 20 producers were observed. The sales in the sector of vehicles included the makes: JOHN DEERE, ZETOR, SAME DEUTZ FAHR GROUP and PRONAR MTZ. The commercial Service Company was launched in the 80's of the twentieth century in the area of agricultural service. The sales for the leading JOHN DEERE make covered administrative area of lubelskie province. The products of the rest of the producers were distributed locally.

### The sales of farm tractors in year 2003

In the analysed period 128 tractors were sold. The range of the bought goods covered products of five producers. The graphical presentation of the sales of farm tractors in separate months of the year 2003 is presented in a histogram (Fig. 1).

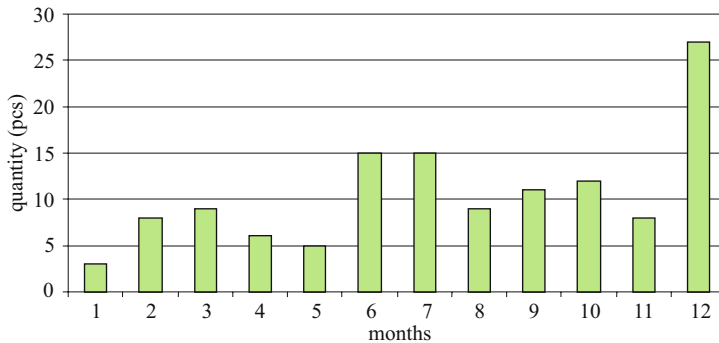


Fig. 1. The graphical presentation of the quantity of the sold farm tractors in the year 2003  
Source: Own study.

The analysis of the quarterly sales was characterised by a growing tendency over the whole year. The level of the sales in the subsequent quarters increased respectively by 30%, 35% and 34%. Throughout the three-quarters regularity was observed, consisting in the fact that the highest turnover was reached in the last month of the investigated period. The lowest demand was observed in January and May. A temporary maximum of demand was recorded in June and July, while the highest level of sales was in December. Throughout the last month of the year 21% of the overall number of tractors were purchased. A rapid increase in sales was due to the subsidies from the EU within the SAPARD programme.

The value of tractors sale in the investigated year is presented in the form of a histogram (Fig. 2).

The analysis of the value of sold tractors confirms that there are relations observed throughout all the quarters with regard to demand. An increased value of turnover in relation to the number of sold tractors occurred in April, June, October and December, the latter being due to the fact that the most expensive models of tractors were purchased then.

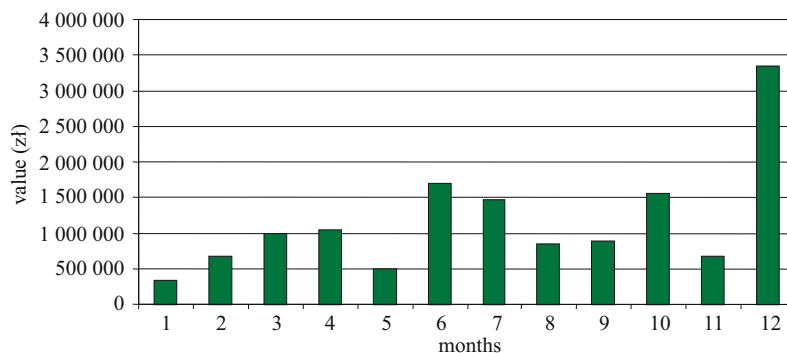


Fig. 2. The graphical presentation of the value of farm tractors sales in 2003  
Source: Own study.

### Farm tractors sale in 2004

In the investigated year 171 farm tractors were sold in general. The full assortment of the purchased vehicles included the tractors of five producers. The distribution of sales in the subsequent months is presented in the histogram (Fig. 3).

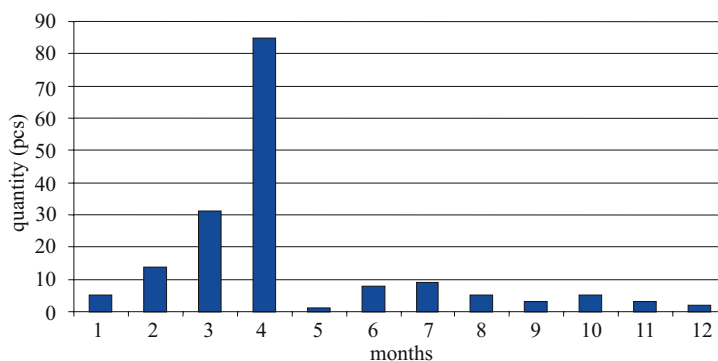


Fig. 3. The graphical representation of the quantity of farm tractors sales in 2004  
Source: Own study.

In the first three months of 2004 there was observed a dynamic growth in the sales, while the maximum level of demand was recorded in April. Within one month 50% of the overall number of tractors sold in the investigated period were purchased. In the first four months 79% of the annual turnover was realised. The dynamics and structure of sales underwent a complete break-

down in the subsequent months. From May to the end of year it oscillated round the level of a few items per month. In the periodical presentation, a tendency pertaining to the three subsequent quarters was confirmed, consisting in the fact that the highest level of sales was reached in the first month of the analysed range. The opposite held true only for the first quarter.

The value of tractors sale in 2004 is presented in the histogram (Fig. 4). The distribution of the tractors sales value confirms the discussed phenomena concerning the quantitative analysis. The structure of demand on models of tractors at different price rates and of various producers was regular throughout the year. Quantitative and value characterisations of the sales in 2004 are similar.

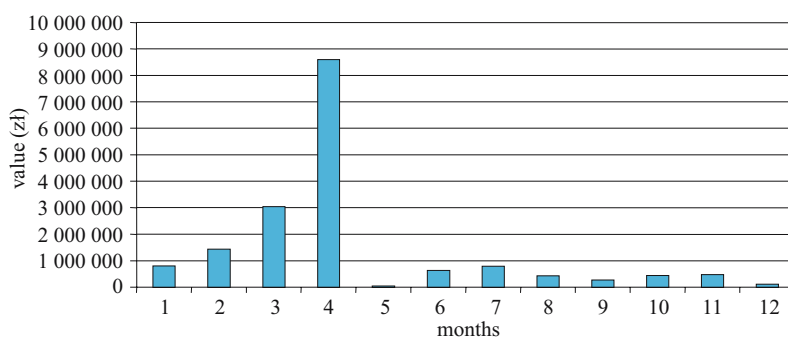


Fig. 4. The graphical presentation of the value of farm tractors sales in 2004

Source: Own study.

The structure of the presented histograms accurately reflects the phenomena that took place on the domestic market of tractors and farm machines. The dynamics and the level of demand were the result of closing the accession period for Poland and entering the EU on 1<sup>st</sup> May 2004. In accordance with EU laws, the VAT rate on farm machines and equipment rose from 0% to 22%.

### Farm machines sales in 2005

In the investigated period 105 farm tractors were sold in general. The sales offer included the products of four companies. The distribution of farm tractors sales in particular months is presented in the histogram (Fig. 5). The analysis of the sales in the quarterly presentation showed an increase in the quantity throughout the year. The first and the second quarter ended in an

equal level of sales, while the third and the fourth quarter the growth was 13% and 27% respectively. What was characteristic was a very low demand in the first month of the year. There also occurred two three-month periods of a balanced level of tractors sale.

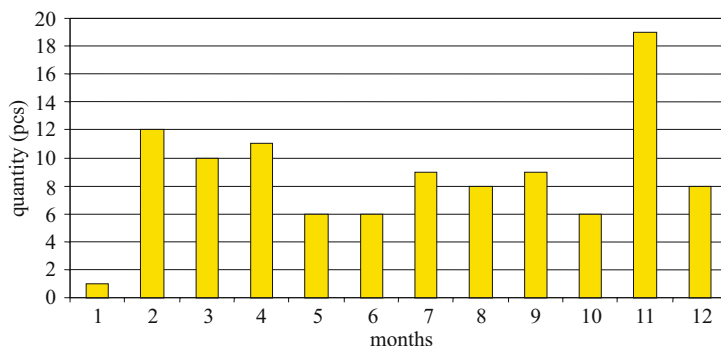


Fig. 5. The graphical presentation of the quantity of farm tractors sales in 2005  
Source: Own study.

An increased demand took place in the period of performing agrotechnical procedures in the spring, as well as in the summer when the harvest was gathered. November was the month of the highest level of the purchased tractors, when their quantity exceeded the average sells level over two times. The distribution of the value of tractors sale in 2005 is presented in the histogram (Fig. 6).

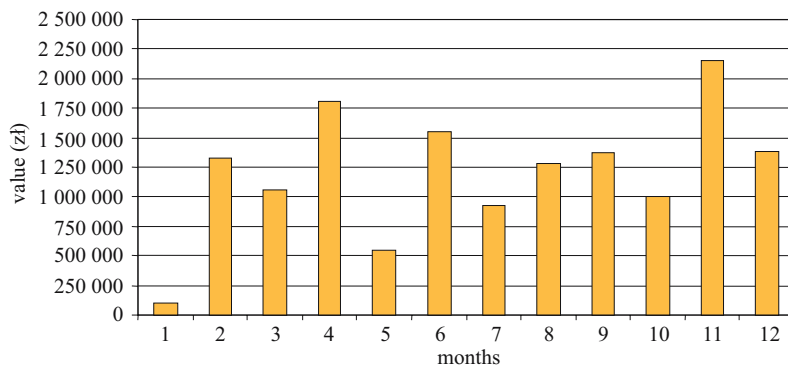


Fig. 6. The graphical presentation of the value of farm tractors sales in 2005  
Source: Own study.

Temporary maxim occurred in April, June and November. A high value of turnover in April and June resulted from a large proportion of the most expensive models in the monthly sales structure. A characteristic feature of the investigated period was a very low value of the sales in January and a rapid drop of the value of turnover in May.

### A comparative characterisation of farm tractors sales in the years 2003-2005

In the analysed period 404 farm machines were sold in general. The highest level of demand was in 2004, as a reaction of the market to the radical and disadvantageous change of sales conditions. The distribution of the sold tractors is presented in the histogram (Fig. 7).

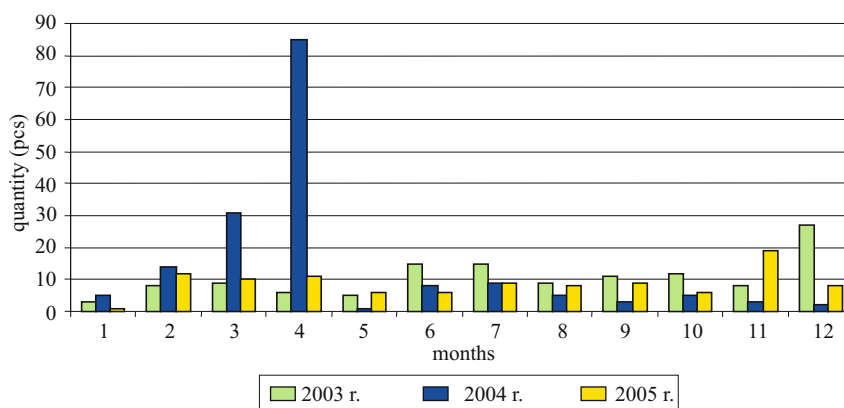


Fig. 7. The graphical presentation of the quantity of farm tractors sales in the years 2003-2005  
Source: Own study.

A comparison of the quantitative and value structure in three subsequent years confirmed the similarities, in spite of different market conditions for farm tractors sale. In January a very low level of turnover was due to the winter, when field works are not performed. The season of spring field works results in a rapid growth of demand on farm tractors. What was characteristic was an abrupt decrease of the level of sales in May. A higher demand took place before the harvesting time than during the harvest of crops. An increase in the level of sales occurred at the end of the year as well.

The quantitative structure of tractors sale is presented in the histogram (Fig. 8).



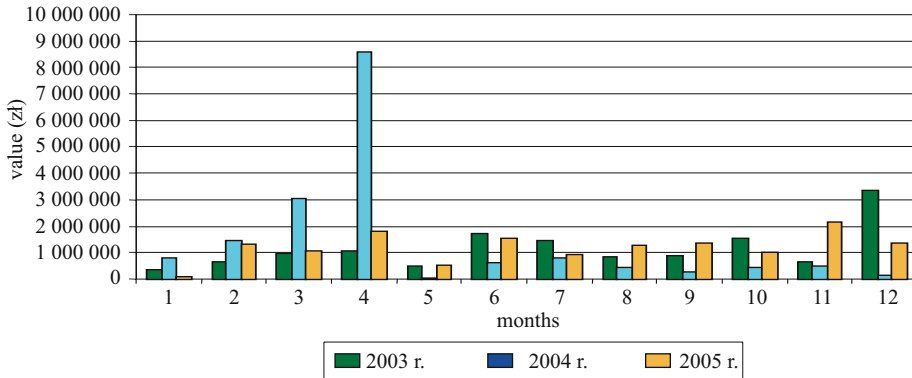


Fig. 8. The graphical presentation of the value of farm tractors sales in 2003-2005  
Source: Own study.

Due to the conflict of interest between the products of ZETOR and SDFG, after two years of equal sales the products of SDFG were withdrawn from the offer of the company at the beginning of 2005. The tractors made by PRONAR MTZ constituted a supplement to the market offer, which included the models at lower price rates. They constituted a few per cent of the investigated market. The quantitative superiority of the tractors produced by an American concern DEERE & COMPANY over the ones from a Czech company ZETOR may be interpreted as a tendency of the market to favour the products, which have rich equipment offer and are at higher price rates.

### A statistical analysis of farm tractors sales in the years 2003-2005

An analysis of farm tractors sales in the investigated period has demonstrated that they were of periodic nature and were prone to seasonal changes. In order to analyse this phenomenon in the aspect of the calendar of agrotechnical procedures, for each time series the quantities and values of the sold tractors, i.e. the seasonal indices, were specified. The analysis has been carried out according to the multiplicative model of the components of time series. The multiplicative model can be expressed by means of an equation (ACZEL 2002, PUŁASKA-TURYNA 2005):

$$Y_t = T_t \cdot S_t \cdot C_t \cdot I_t \quad (1)$$

where:

$Y_t$  – value of the series

$T_t$  – trend of a series

$S_t$  – seasonal variation

$C_t$  – cyclic variation

$I_t$  – irregular variation

The value of seasonal indices has been calculated on the basis of moving average for 12 monthly observations. The calculated indices show seasonal effects in the time series for the quantity and value of the sold tractors. When analysing the influence of the seasonal variation on the distribution of the quantity and value of the sold assortment, the notion of (average) level value has been employed, which for seasonal indices in particular months amounted to 100%.

### A statistical analysis of the quantity of sold farm tractors

The value of seasonal indices for the quantity of farm tractors sold in years 2003-2004 is presented in the graph (Fig. 9).

At the beginning of the year, when the field agrotechnical procedures were performed, farm tractors sale was lower than the reference level by 77.7%. Due to seasonal variations in the three following months, the level of the sales exceeded the average level: in February by 38.9%, in March by 68.2% and in April by 238.6%. The spring months are the period of particularly intensive agrotechnical procedures and, at the same time, of high demand for driving power source and towing power, that is for tractors.

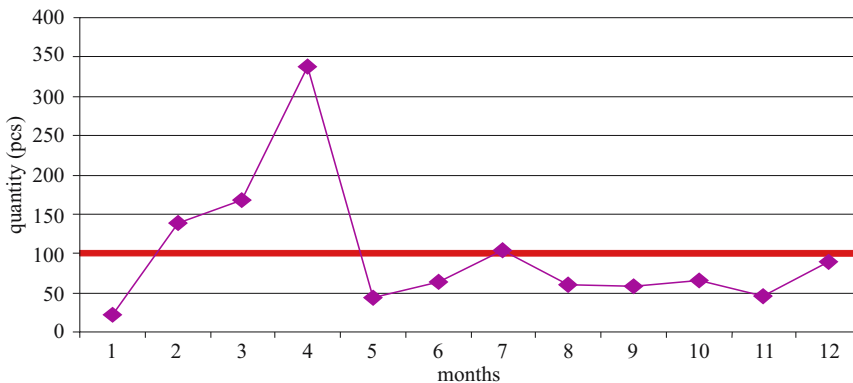


Fig. 9. Seasonal indices for the quantity of sold farm tractors in the years 2003-2005  
Source: Own study.

The calendar of agrotechnical procedures includes in this period sowing of spring cereals, planting bulb and root plants and sowing spring oleaginous plants (*Agrotechnika roślin uprawnych* 2005, *Agrotechnologia* 1999). It should be stressed that two subsequent months show considerable decrease in demand. So, in May it was lower than the average by 56.2% and in June by 36.8%. In July the sales increased and the sales exceeded the average level by 4.6%. This temporary maximum is connected in the calendar of agricultural operations with the beginning of gathering crops. The level of demand from August to November, due to seasonal variations constituted 50% of the reference level. The end of the year was the time, when the demand increased, but it was still below the average.

### A statistical analysis of the value of sold farm tractors

The value of seasonal indices for the value of farm tractors sold in years 2003-2004 is presented in the graph (Fig. 10).

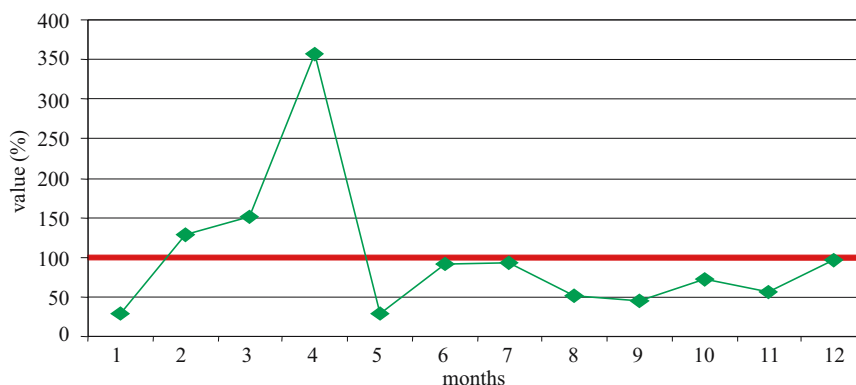


Fig. 10. Seasonal indices for the value of sold farm tractors in the years 2003-2005  
Source: Own study.

General characteristic of the line in the graph confirmed all the features of the values of tractors sales described in the commentary on the indices for the quantity of the bought vehicles. The significant decrease of the demand took place in January and May, when there was no field labour included in the calendar of agrotechnical procedures. The spring months confirmed higher level of the sales, and June and July reached the reference level. The long-lasting reduction in sales during second half of the year ended in December.

## Summary

The purchaser's satisfaction from complex customer service and then, from prompt supply of the bought tractors run by the Commercial Department of the dealer company, is a basic condition of building long-term co-operation. The loyal purchaser is not prone to jump at an offer of competing companies during the whole process of using technical products.

The effective selective distribution of farm tractors and machinery requires thorough knowledge of agricultural market. The sudden increase and the high level of demand for farm tractors over short period of time generate a number of logistic objectives. A successful customer service is then the result of implementing the solutions based on logistic systems that function in a net of distribution inside and outside the commercial Service Company.

The value of the seasonal indices in the investigated period of years 2003-2005 indicates that there is a relationship between the level of sales and the calendar of agrotechnical procedures. The level of demand provided farm households with new tractors, especially during the spring months. This allowed using them fully, as the source of energy during the whole season in a given calendar year. The purchase at the beginning of the period had also a significant economical aspect for the farm households. Investment in these kind of fixed assets allowed benefiting from current use of tractors. The purchasers bought more tractors before the harvest time than during intensive field labour. Another distinct increase of the level of sales took place by the end of the year and was connected to investments into fixed assets coming from the income from the current activities of farm households.

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