

MAINTENANCE COSTS OF INTENSIVELY USED SELF-PROPELLED MACHINES IN AGRICULTURAL COMPANIES

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Abstract. The problems connected to the maintenance of tractors in agricultural enterprises have not been studied in recent years. In this article an overview of what the current situation is with the diagnostics of tractors, repairs and maintenance works in reality is given. In the present research the maintenance costs of agricultural tractors in the Republic of Estonia have been investigated. Classification and evaluation of the costs were carried out both by different brands and also by different tractor types, statistics on the reliability of tractors was made in realistic working environment. As an example some data about the maintenance costs in several of the biggest agricultural companies in Estonia are presented. The data have been collected in the accounting departments through personal contacts and were rendered with the condition that they be used for scientific purposes only and the names of companies not revealed. The data are unique as they have not been given to anybody else and therefore no such research exists up to now. In the yearly reports presented to public institutions all the different expenses are put together under one line and therefore our research which investigates different expenses separately is unique in its own way. Companies where the bookkeeping was not very specified were left out of the research (about 30 %).

Keywords: tractor, repairs, maintenance, diagnostics, maintenance costs.

Introduction

As a result of replacing the older tractors with newer ones, the maintenance of tractors in agricultural companies has become more dependent on the diagnostics, repair and maintenance services provided by the official service centers. We do not have an overview of the productivity nor usage and maintenance costs of the Estonian most widely used old tractors (*MTZ*) and tractors. Neither is there any comparison, based on a singular company, between the capacities of different tractors and at which rate they are used during intensive agricultural periods [1; 2].

During the research we set the following tasks:

1. To find out the types and volumes of tractor usage and maintenance costs (filters, lubricates, spare parts, gasoline, wheels, labor costs and etc.) and the accessibility to this kind of data.
2. To compare the costs of different tractors in order to find out the most optimal brands for Estonian farmers.
3. To investigate the changes of expenses during the last three years in order to work out a bases model for calculating the resources of tractors in the Estonian conditions [3; 4].

Materials and methods

To analyze the costs of spare parts in agricultural companies we used the data on maintenance costs collected by the accounting departments. Usually the source of information was the chief engineer (other than the general information about the company and costs on fuel). The data that we managed to get from the chief engineer did not come directly from the accounting department but were their personal calculations and overviews on expenses. Each chief engineer had their own personal „accounting“.

While choosing the companies we set two points of criteria:

- the trustworthiness, transparency and availability of the accounting materials;
- the companies' last year turnover had to be more that 1 million Estonian EEK, the basic data of this research were collected during the spring of 2008. According to the Law of Competition and in order not to harm the interests of the company, we named it *Agro III*.

In this paper we investigated the tractor maintenance costs in *Agro III* during the last three years. More precise division of expenses has been done based on the data of the year 2007. According to the accounting department the company has all together 89 tractors. Among those there are represented 10 brands of Western tractors that constitute a total of 23 tractors. The remaining 66 tractors are from Russian or Belarus origin: *MTZ, K-701/K-700, T-150K, JUMS*. The western brands are as follows:

Case, CAT, Daewoo, Fendt, JCB, John Deere, Manitou, Massey Ferguson, MTZ, Same, Valtra-Valmet. The division of the motor fleet based on the brand is shown on Fig. 1.

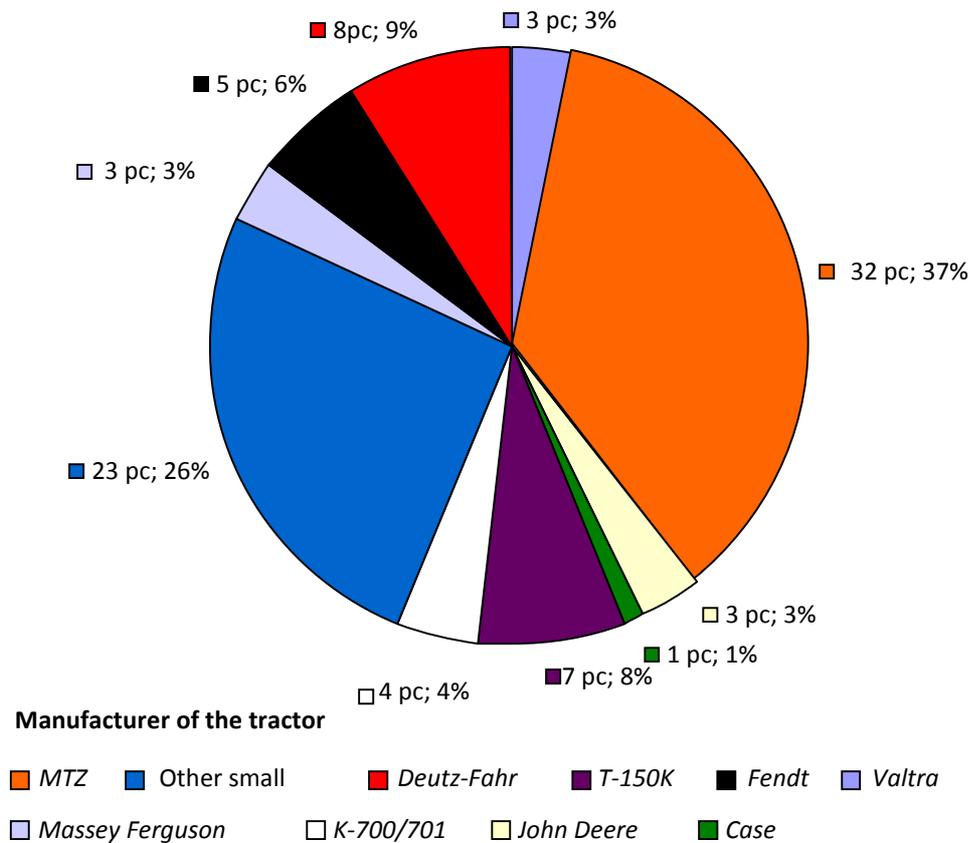


Fig. 1. The division of tractors in Agro III based on the manufacturer

Results and discussion

The Maintenance costs of the machine fleet. We look at the maintenance costs with a broader view, taking into account also the combine harvesters, trucks, cars – all the equipment that moves. The costs on lubricates, oils, filters, tires, spare parts, maintenance and other costs were under investigation.

As spare parts we consider all kinds of aggregates and other materials: belts, gaskets, hoses, brake shoes, clutch discs, bearing, batteries, windows, doors, lights, seats, ventilators. The maintenance costs involve the maintenance and repairs works that were done outside the company and the materials that were used during those works. Other costs involved incandescent lamps, auto fuses, cleaning detergents, window cleaning liquid, fire extinguishers, reflectors, paint, rust death etc.

In addition to the maintenance cost we have also shown the costs on fuel. The company has four gas stations for its own purposes and the price of fuel per month in 2007 is shown in Figure 2. In 2007 the costs of fuel rose 32 % and the tendency was towards rising.

Agro III has been built on the bases of a Soviet Union collective farm and most of its tractors are from that era (older than 16 years). 16 % of the tractors are 7-15 years old and 12 % of the tractors are up to 6 years old.

Most of the tractors (57 %) belong to the class that has up to 90 HP. Equally 5 % of the tractors have 91-130 HP and 171-200 HP. 13 % of the tractors have between 131-170 HP while 9 % of them have more than 200 HP. Most of the field work is done by machines that have more than 200 HP. As they are used intensively their useful life is around 3-4 years.

Maintenance costs of tractors. According to the data in 2007 all together 116 116.95 EUR were spent on tractor maintenance, which is 8 % less than in 2006 (Figure 3). In 2007 the average fuel consumption was 95 L·ha⁻¹. On an average 1 304.65 EUR were spent on the maintenance of each

tractor. This means that the maintenance cost per hectare was 20 EUR. The problem is long distances between fields which raised the overall fuel consumption. On 100 EUR that was spent on fuel we have to add 43 EUR worth of maintenance works.

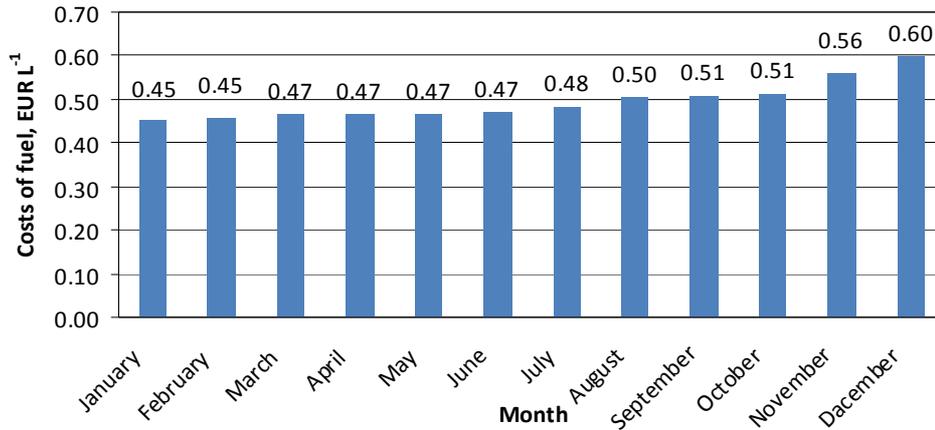


Fig. 2. Agro III cost of fuel in 2007

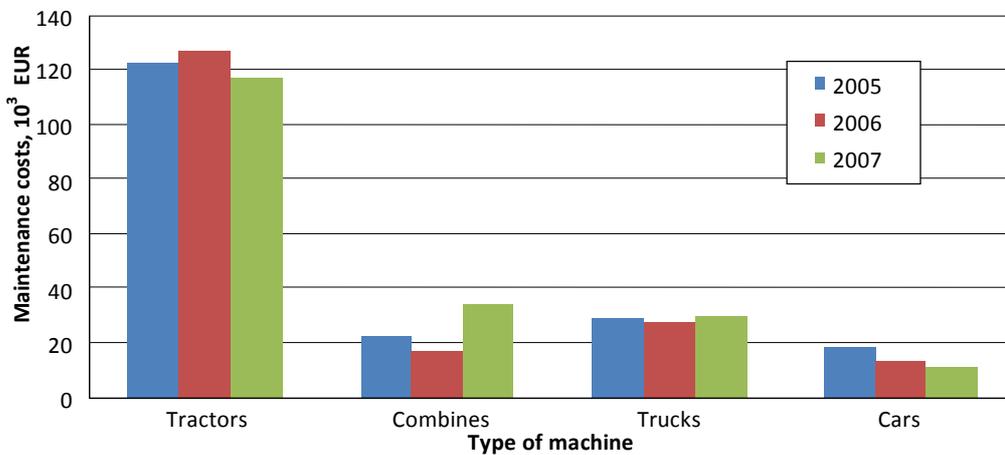


Fig. 3. Maintenance costs per year during the last 3 years

Fig. 4 compares the relation between the fuel consumption and maintenance costs on monthly bases in 2007. Repairing is seasonal work and therefore December, January, February and March are the months where the costs of maintenance are higher than the cost on fuel.

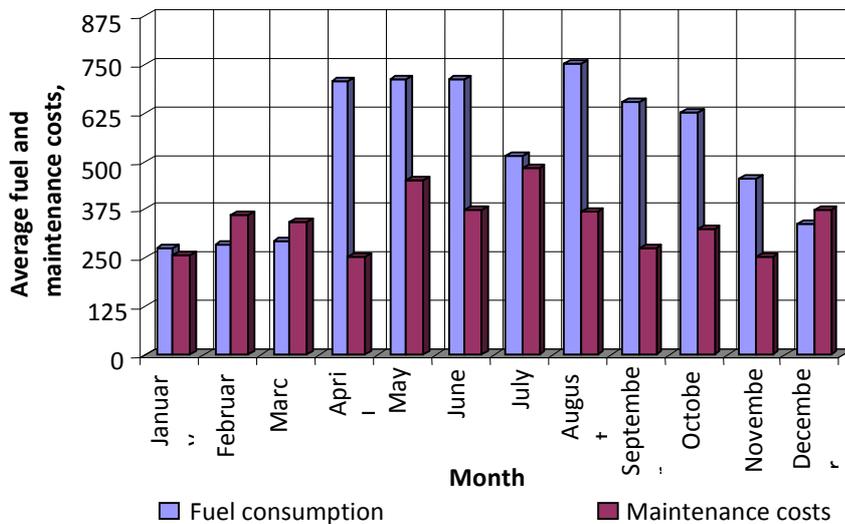


Fig. 4. Average fuel and maintenance costs per month in 2007

Expenses on different brands of tractors. The average costs of *Valtra* tractors are shown in Fig. 5. We can see that in 2007 no new tires were bought for these tractors and that the maintenance costs are very similar to the expenses on fuel (the difference is 5 %).

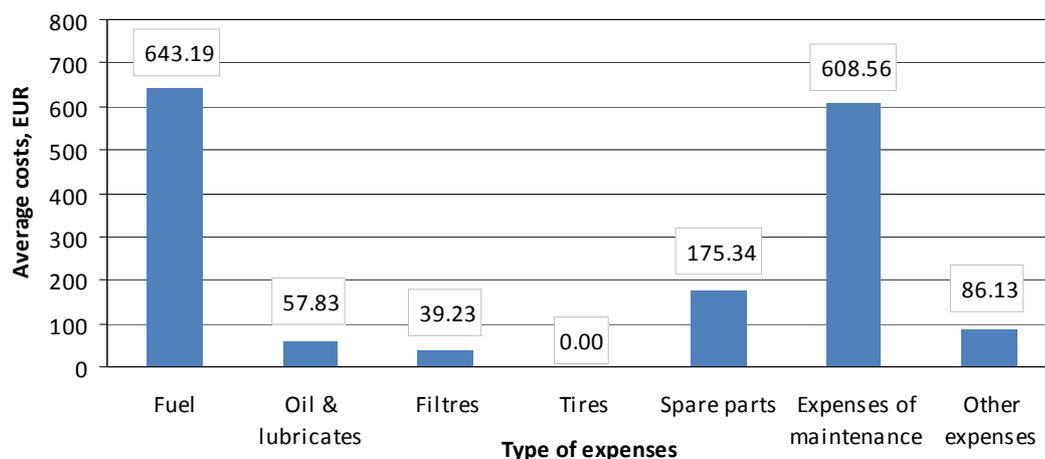


Fig. 5. Average expenses on *Valtra* tractors in 2007

The expenses of *MTZ* tractors do not include costs on oil and lubricates (Fig. 6) because in reality these materials come from the stock left behind by the collective farms. The expenses on tires are similar to the expenses on fuel.

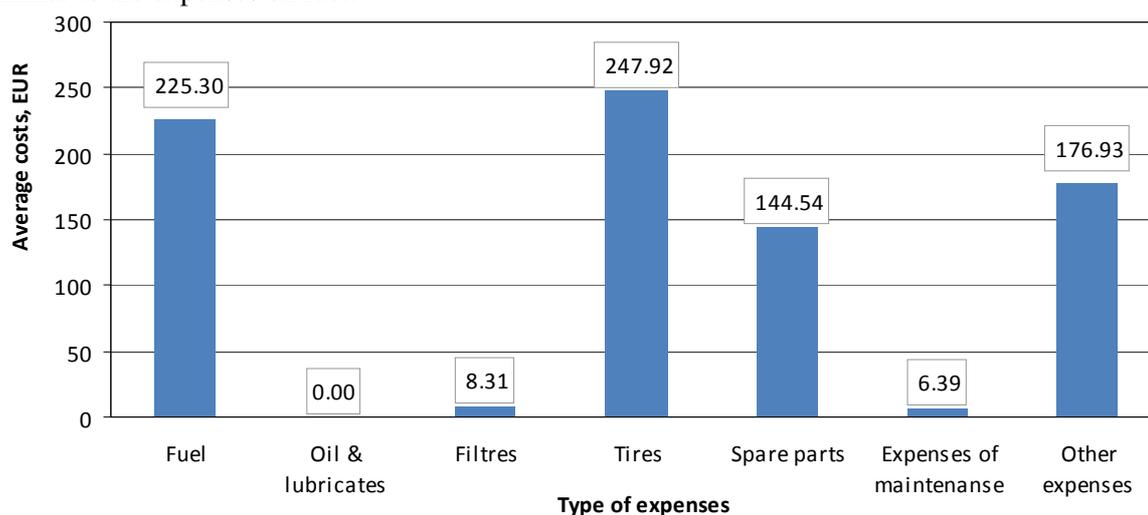


Fig. 6. Average expenses of the *MTZ* tractors in 2007

The expenses on *John Deere* are shown in Fig. 7. The expenses on tires are remarkable. All in all they make 75 % of the total maintenance costs. It costs 3 860.30 EUR to change one tire. When comparing this cost to the cost of fuel, one tire is 3.6 times as expensive as the cost of fuel.

There is only one *Case* tractor in the company and in 2007 it did not have any expenses on oil, lubricates or tires. At the same time it had very big fuel consumption, 845.45 EUR and even bigger maintenance costs, 1 089.95 EUR.

From the data regarding the *T-150K* we can see that this tractor is not used very intensively and the expenses are only minor (fuel – 262.05 EUR; spare parts – 266.25 EUR).

K-701 tractors did not have any expenses on oil and lubricates because similarly to the *MTZ* tractors, the leftover materials from stock were used. Other expenses were on fuel (545.90 EUR) and tires (624.75 EUR).

The average expenses on *Massey Ferguson* tractors do not include costs on tires because in 2007 no tires were bought. Considering the intensity of usage of these tractors the average costs are quite low. On fuel there were 1567.30 EUR spent, on spare parts 399.50 EUR and on maintenance 153.15 EUR.

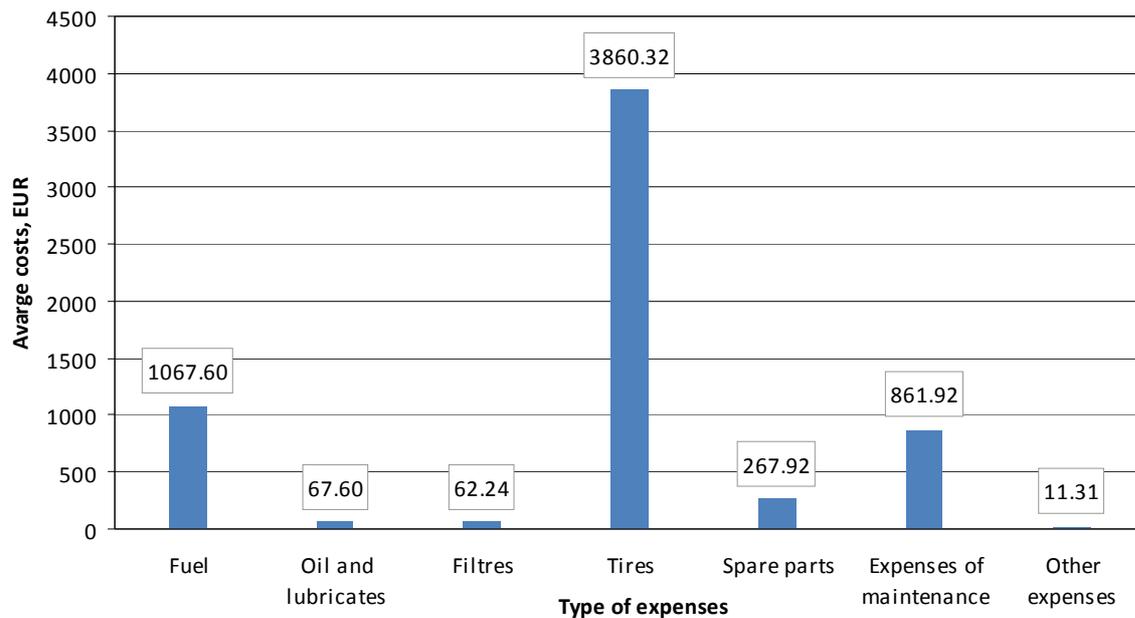


Fig. 7. *John Deere* average expenses in 2007

The data about the *Fendt* tractors (Fig. 8) include all the types of expenses and the average costs can be compared to *Valtra*, *John Deere* and *Massey Ferguson* tractors as they all belong to similar power categories and do similar jobs.

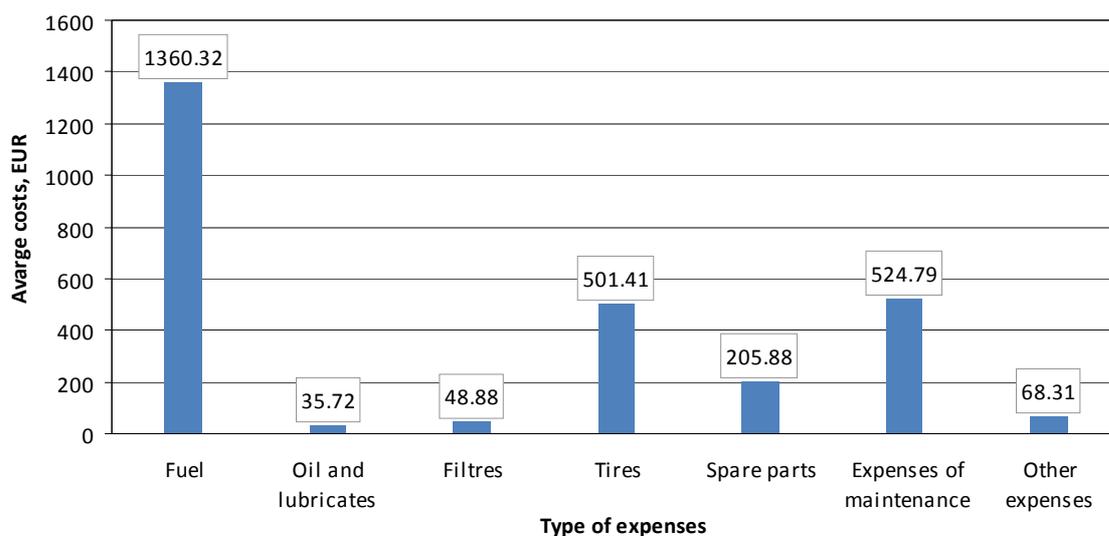


Fig. 8. *Fendt* tractor average expenses in 2007

The maintenance costs of combine harvesters. Between 1997 and 2002 132 combine harvesters were bought in Estonia. Considering the conditions in Estonia, the Western machines are used very intensively – more than 1000 ha·year⁻¹.

Agro III uses only one brand of combine harvesters and all of them have more than 200 HP. Compared to the tractors the combines are newer: there is one machine that is less than 3 years old, three machines are between 4-6 years old and two machines are between 7 and 10 years old.

All together 34 493.16 EUR were spent on the maintenance of the combine harvesters in 2007, which is 106 % more than in 2006. On an average each combine harvester needs 5 748.70 EUR for maintenance. Based on the data of 2007 the average fuel consumption was 14 L·ha⁻¹. The maintenance constituted 86 % of the expenses on fuel, meaning that for every 100 EUR spent on fuel we have to add 86 EUR for maintenance, which is twice as much as the money spent on the tractors (43 %). The estimated cost of maintenance for the combines was 5.95 EUR for a hectare of harvested land. In 2007

the combines used a total of 79 190 L of fuel. The average expenses spent on spare parts per month in 2007 are shown in Fig. 9.

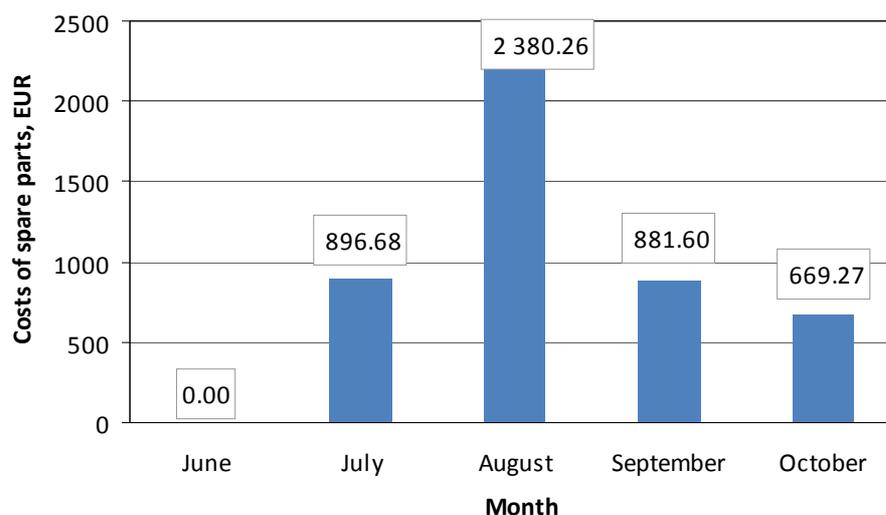


Fig. 9. Combine harvesters average expenses spent on spare parts per month in 2007

Although in 2007 not too many maintenance works were done on combines, the sums that were spent on it are impressive, all together 6 134.20 EUR.

Maintenance costs of trucks. In 2007 the maintenance costs spent on trucks were 30 232.55 EUR, which is 10 % more than in 2006. Mostly spare parts were needed especially for the GAZ 53 (break shoes, hoses and head lights). The expenses on spare parts per months in 2007 are shown in Fig. 10. Considering the prices of spare parts, the overall expenses are not that big.

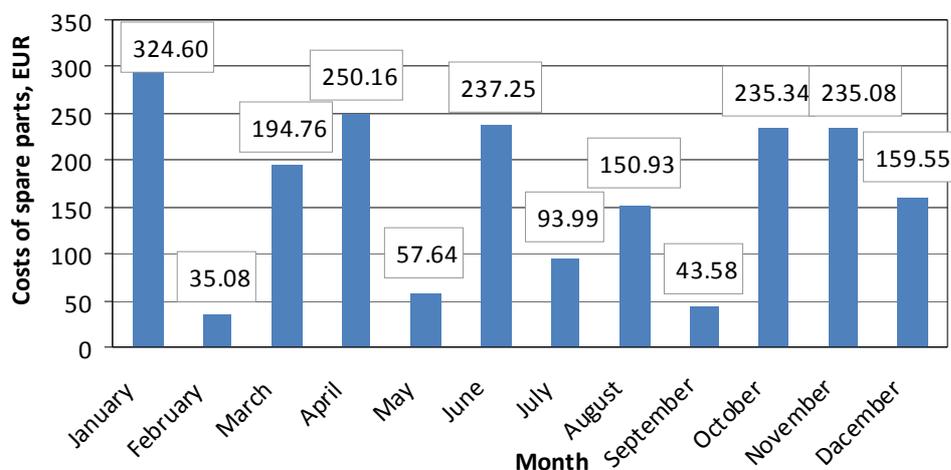


Fig. 10. Average expenses for spare parts of trucks per month in 2007

Conclusions

1. For the first time there has been found a link between the work done by the new tractors and their maintenance costs. The expenses are quite spectacular, on an average 1 305.30 EUR per tractors. It is estimated that for every hectare of cultivated land a tractors needs 20.5 EUR for maintenance.
2. We have found that the data given by one specific agricultural company about its different expenses is reliable and actual. For the people who deal with the maintenance of machines this can be an orientate price line while planning and organizing the works of the tractor fleet.
3. The estimated fuel consumption per cultivated hectare is 95 L. For every 100 EUR of the consumed fuel we should add 43 EUR for maintenance.
4. Based on the data, the combines used on an average $14 \text{ L}\cdot\text{ha}^{-1}$ of fuel. For every 100 EUR of the consumed fuel we should add 86 EUR for maintenance.
5. The estimated maintenance cost for the combines is 5.95 EUR per cultivated hectare.

6. The data shown in this paper are based on tractor types as a whole and specific modifications of each tractor are not shown. This is a negative aspect of the method used and should be taken into account in future researches.

References

1. Estonian Rural Development Strategy 2007-2013. Ministry of Agriculture, 2008. 44 p. [online] [30.04.2010.]. Available at: http://www.agri.ee/public/juurkataloog/MAK/RDP_2007-2013.pdf.
2. Klaus A. Agricultural production is concentrated in large farms. Ministry of Agriculture, 2006, 1 p. (in Estonian). [online] [30.04.2010.]. Available at: <http://www.agri.ee/index.php?id=21664&highlight=Klaus,A>.
3. Estonian Rural Development Plan 2007-2013. Ministry of Agriculture, 2006. 44 p. [online] [30.04.2010.] Available at: <http://www.agri.ee/public/juurkataloog/MAAELU/MAS/ERDPS2007-2013.pdf>.
4. Karjane I. The tractor as a leader of technical progress. EMVI Tallinn-Saku, 2005. 17 p. (in Estonian).