

RESULTS OF INVESTIGATIONS ON THE UTILISATION OF AGRICULTURAL MACHINES IN CONDITIONS OF COMMERCIAL FARMS

Summary

The aim of this study was to evaluate the utilisation of agricultural machines in conditions of commercial farms. The obtained research results were compared with data used so far to calculate operating costs of machine work in agriculture. An increase in the annual machine utilisation was observed ranging from 6 to 180%, depending on the type of the analysed agricultural machines.

WYNIKI BADAŃ WYKORZYSTANIA MASZYN ROLNICZYCH W WARUNKACH GOSPODARSTW TOWAROWYCH

Streszczenie

Celem pracy było oszacowanie wykorzystania maszyn rolniczych w warunkach gospodarstw towarowych.. Wyniki badań porównano z danymi stosowanymi dotychczas w kalkulacjach kosztów eksploatacji prac maszynowych w rolnictwie. Zaobserwowano wzrost rocznego wykorzystania maszyn, który wynosi od 6 do 180% w zależności od rodzaju maszyn rolniczych objętych badaniami.

1. Introduction

From the point of view of economics of work of agricultural machines, the intensity of their utilisation is of key importance. One of the basic parameters of utilisation intensity of agricultural machines is their output capacity which is measured by the number of performed labour units (hours, hectares, tons etc.) in a year. Values of annual machine utilisation belong to technical-operational indices and are essential for the determination of unit running costs of agricultural machines [7].

Technical advances in the construction of modern agricultural machines as well as changing conditions of their utilisation in agricultural farms cause that values of agricultural machine utilisation established many years ago have become outdated and are no longer valid. Calculations of machine operational costs carried out using current values of this parameter are burdened with error. That is why it is expedient to take up research problems associated with the evaluation of contemporary values of agricultural machine utilisation.

2. Objective of the research project

The main objective of performed investigations was to assess true values of annual agricultural machine utilisation used in conditions of commercial farms. In addition, the study compares the obtained empirical research results with theoretical data which have been employed until now to calculate operational costs of agricultural machines in Polish agriculture.

3. Research methodology

The investigations which were conducted in 2008 included 16 agricultural farms in the region of Wielkopolska and the area of the examined farms ranged from 12 ha to 160 ha (mean farm area – 66.3 ha). Out of the examined 16 farms, 11 were dual-purpose farms specialising both in animal and plant production, whereas the remaining 5 farms were single-purpose units specialising either in animal (4 farms) or plant (1 farm) production. The size of the

investigated farms as well as the employed production methods and the extent of specialisation all qualified them to be classified as commercial farms from the point of view of market economy [2].

The selection of the examined farms was intentional because they guaranteed that the required information obtained from them would be most comprehensive and they also met the criterion of availability of sample elements [3]. In the course of the performed experiments, data comprising annual utilisation of machines on the farm and outside it were registered. Therefore, the registered output capacity of agricultural machines took also into account their utilisation when they provided services away from their original farm [7].

4. Research results and their discussion

Data obtained in the course of empirical investigations were initially processed and the results are collated in Table 1. The table presents minimal and maximal values of the annual utilisation of the examined agricultural machines. Additionally the Table includes calculated mean values of utilisation of individual types of agricultural machines in the course of year.

Results of utilisation intensity of agricultural machines obtained in the course of investigations were compared with theoretical data elaborated by the Institute of Rural Construction, Mechanisation and Electrification (IBMER) in Warsaw. These data are currently used to calculate costs of machine work in domestic agriculture [5]. The results of the comparison of mean annual utilisation of the examined machines with appropriate theoretical values are illustrated graphically (Figures 1 and 2).

The results presented in Figures 1 and 2 show that values of true utilisation of the examined machines are higher in comparison with theoretical data employed so far to determine operational costs of agricultural machines. Therefore, percentage increase of the true utilisation of the examined agricultural machines in relation to IBMER data [5] was calculated. The results obtained from the performed calculations are presented in a graphic form in Figures 3 and 4.

Table 1. Utilisation of the examined agricultural machines in the examined commercial agricultural farms

No.	Itemisation of agricultural machines	Machine utilisation [h/year]		
		minimal	maximal	average
1.	Agricultural tractors 25-49 kW	310	1200	660
2.	Agricultural tractors 50-64 kW	500	1000	900
3.	Agricultural tractors 65-79 kW	300	1000	680
4.	Agricultural tractors 80-95 kW	200	1000	700
5.	Agricultural tractors over 95 kW	600	2000	1200
6.	2-axle tip trailer 4-10 t	275	650	459
7.	Telescope loaders	250	2000	840
8.	4-furrow ploughs	20	200	88
9.	Cultivation aggregators 3-4 m	45	100	79
10.	Manure spreaders 8-10 t	60	130	103
11.	Fertiliser distributors 15-18 m	15	50	34
12.	Field sprayers 12-15 m	14	250	80
13.	Drum mowers 1.6 m	50	100	70
14.	Roll balers	15	300	105
15.	Combine cereal harvesters 88-118 kW	75	200	133

Source: Own investigations

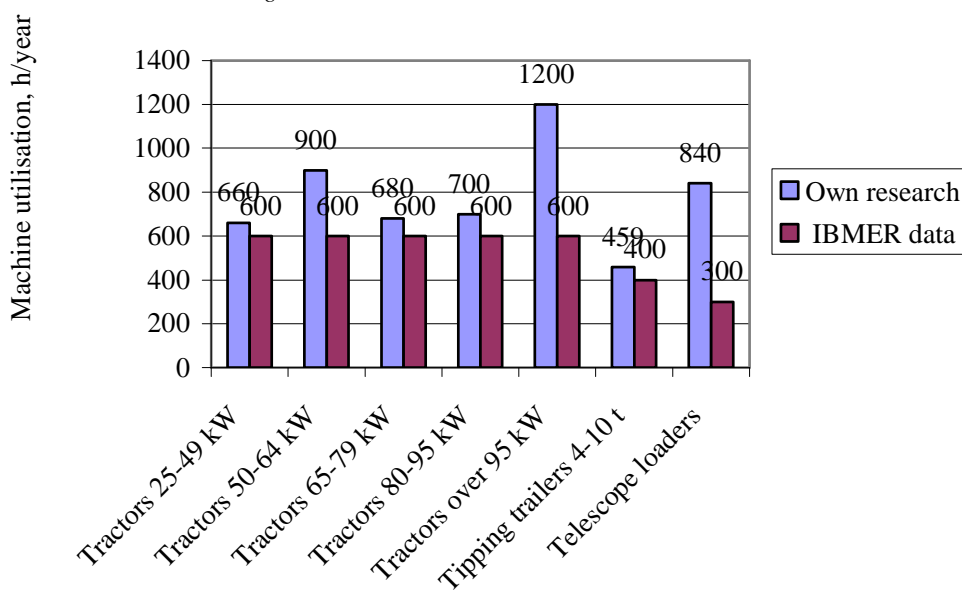


Figure 1. Comparison of the results of utilisation of energy and transport means (source: own investigations and [5])

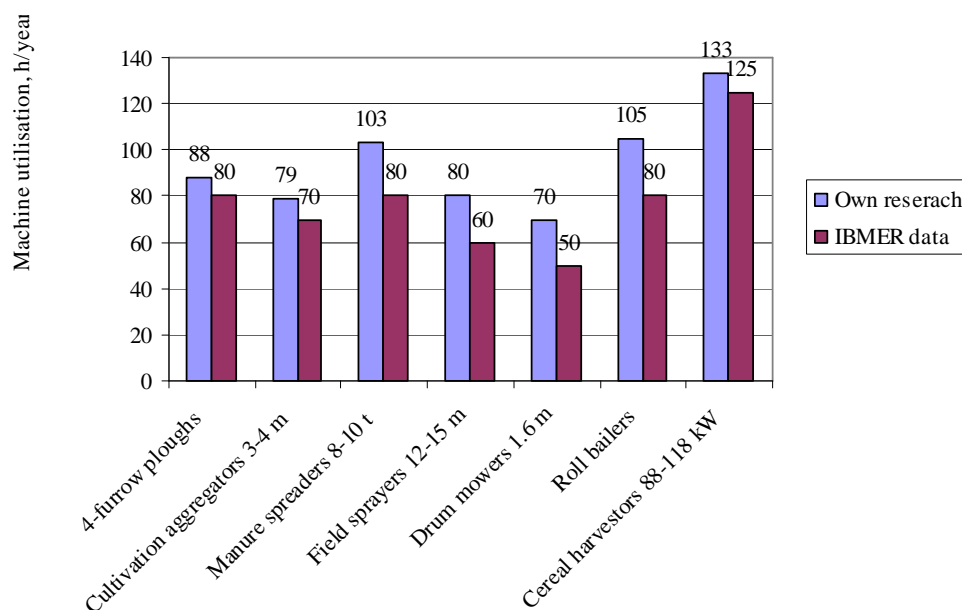


Figure 2. Comparison of the results of utilisation of machines for soil cultivation, fertilisation, plant protection and harvesting of crop plants (source: own investigations and [5])

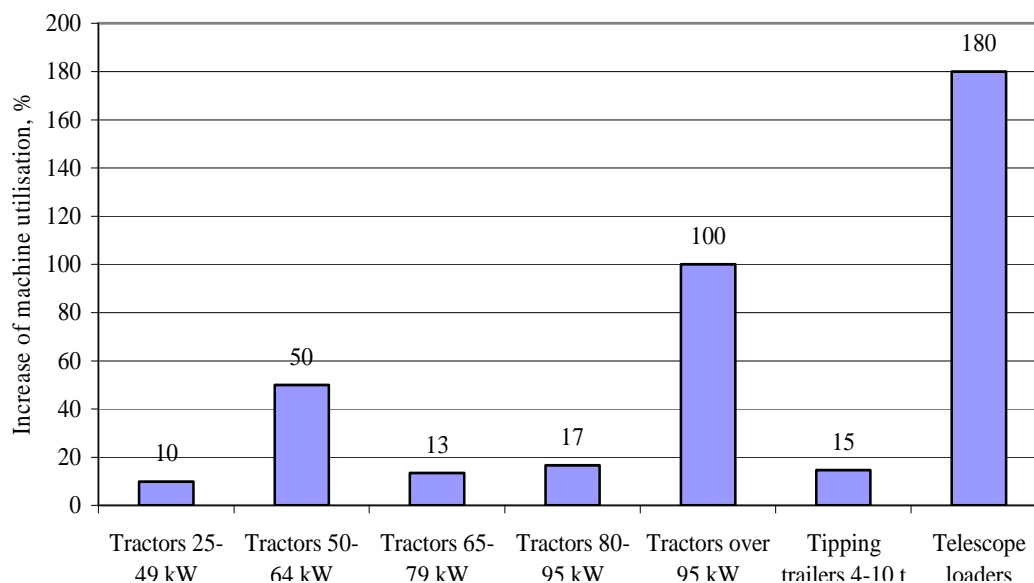


Figure 3. Percentage increase of utilisation of energy and transport means (source: calculations on the basis of own investigations and [5])

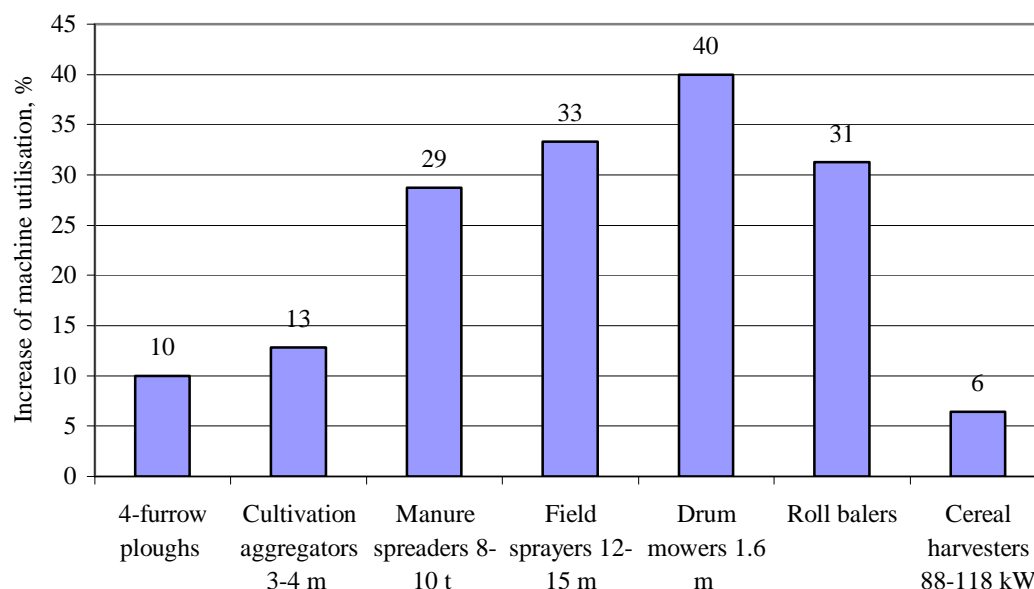


Figure 4. Percentage increase of utilisation of machines for soil cultivation, fertilisation, plant protection and harvesting of crop plants (source: calculations on the basis of own investigations and [5])

In the group of energy means, the annual utilisation increase of machines in the examined farms ranged from 10 to 180% depending on the type of machines. The greatest increase of the utilisation intensity of, respectively, 100 and 180% was observed in the case of high power (more than 95 kW) agricultural tractors and self-propelled telescope loaders. The above-mentioned machines were usually either new or used but in very good technical condition and they were utilised in the examined farms on a continuous basis. These machines were among the most efficient agricultural machines tested in this study. In addition, telescope loaders provide a good example of the application in recent years of technological innovation in Polish agriculture. The observed considerable output capacity of telescope loaders (on average - 840 h/year) was the result of their intensive utilisation in animal production. Despite considerable

proportion of transport works in the analysed farms, a relatively low utilisation of agricultural trailers was recorded (increase of annual utilisation - 15%). This relatively lower mean value of annual utilisation (Tab. 1) can probably be attributed to the fact that, most frequently, there were several different trailers of different load capacity (4-10 t) in the examined farms.

From among the machines presented in Figure 4, the increase of their annual utilisation ranged from 6 to 40%. In this group of agricultural machines, the highest increases in true utilisation were observed in the case of drum mowers (40%), field sprayers (33%) and roll balers (31%), while the lowest increase in annual utilisation was recorded for cereal combine harvesters - 6%. The latter included mostly several-year old or even older harvesters that had already reached the assumed period of standard utilisation.

5. Conclusions

In the light of the performed empirical investigations and calculations as well as the analysis of the obtained results the following conclusions were drawn:

1. The most important purpose of the study was to compile a database with true utilisation values of agricultural machines. The collected database should make it possible to evaluate more accurately the entire system of operation of agricultural machines, including its costs. Therefore, the results obtained from the investigations should be used in agriculture advisory services to determine costs of machine works using the agricultural machines examined in this study.
2. True values of annual machine utilisation determined in the course of the described experiments were higher in comparison with theoretical values employed so far to calculate costs of machine work in domestic agriculture. The determined percentage increase of annual machine utilisation ranged from 6 to 180% depending on the type of the examined machines. This confirmed the advantageous effect of technical progress expressed in increased operational potentials of modern agricultural machines. In addition, differences in machine utilisation cause that true values of agricultural machine utilisation should be taken into account more and more frequently in the process of calculations of running costs.
3. The continuous advance of the technical reconstruction of Polish agriculture requires widening of empirical database in the area of utilisation of new constructions of agricultural machines which have not been object of this

type of research. Among the examples of this kind of machines are: telescope loaders, self-propelled sprayers etc. which lack information regarding their standard utilisation in Polish agriculture. Calculations of operational costs of new constructions of agricultural machines sometimes require application of annual utilisation coefficients which are based on Swiss or German data [1, 4] despite the fact that the specificity of agriculture in those countries differs from Polish agriculture. Therefore, it is necessary to continue empirical investigations with the aim to elaborate current coefficient values of agricultural machine utilisation in Polish agriculture.

6. Literature

- [1] Ammann H.: Maschinenkosten 2005. FAT-Berichte, Agroscope FAT Tänikon. Nr 621.
- [2] Fereniec J.: *Ekonomika i organizacja rolnictwa*. Wyd. Key Text, Warszawa 1999.
- [3] Klepacki B.: *Zasady wyboru próby do badań ekonomiczno-rolniczych*. Roczniki Nauk Rolniczych, 1987. Seria G, T. 84, Z. 3.
- [4] KTBL-Taschenbusch *Landwirtschaft* 2002/2003. KTBL, Darmstadt.
- [5] Muzalewski A.: *Koszty eksploatacji maszyn*. Nr 21. Wyd. IBMER, Warszawa 2006.
- [6] Rzeszowska W.: *Wyposażenie techniczne gospodarstw w aspekcie przystąpienia Polski do Unii Europejskiej*. Praca magisterska pod kierunkiem dr. Z. Grzesia. Maszynopis. UP w Poznaniu 2009.
- [7] *System Maszyn Rolniczych*. Część 14, Wskaźniki eksploatacyjno-ekonomiczne. Wyd. IBMER, Warszawa 1988.