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ANNUAL USE AS A CRITERION FOR SELECTION OF A COMBINE HARVESTER UTILISATION FORM

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ABSTRACT

The objective of the study was to decide which alternative of using mechanization services by farms, namely the purchase of new or second-hand technical equipment on the example of grains combine harvesters should be taken into consideration. Two typological groups of grain combine harvesters were created. In the selected groups the following models responded to an average combine harvester: A – Bizon Z056; B – John Deere 1450 CWS. Limit points balancing the price of service in working hours and the surface area in hectares designed to be harvested were established. Investigations showed, that the purchase of a new combine harvester will be rational only in these farms, where minimum acreage of grains and technologically similar plants will be achievde: group A – 128 ha; group B – 173 ha. If these services are unavailable, farms can afford purchase of the second-hand equipment for an average price which does not exceed: 89,530 PLN for group A and 176,315 PLN for group B.

Introduction

Individual farms in Poland are diversely equiped with mechanization means. This applies to both the number as well as the type, age and technical condition of machines and equipment. A relatively small size of the average farm with a simplified structure, not of very high intensity, low level of services in the close neighbourhood, and thereby often with too many technically and technologically obsolete machinery influence a low level of annual use of the equipment. This situation generates high cost of mechanization, which raises the level of total production costs and consequently decreases the income (Pawlak, 2011). Taking into account insatisfactory condition of the machinery park some farms have already started its modernization with EU funding (Zając et al.,, 2012). The remaining units are at the stage of planning mechanization investments or consider termination (Szuk, 2009). Rationality of purchase and use of mechanization funds determines the level of costs and its impact on the final result of production (Komarnicki et al., 2012). Therefore, a problem of rational choice of the form of use of particularly high-value machines seems to be crucial (Muzalewki, 2007). The form of use determines the manner and extent of mechanization means, which may be limited to one or multiple farms. These forms are the most frequently distinguished: individual, team, service and mixed (Pawlak, 2011).

Objective, scope and methodology of research

Therefore, the objective of this study was to carry out a scientific attempt to decide which alternative for using farm mechanization services namely the purchase of a new or used technical equipment is more beneficial on the example of combine harvesters.

Tests were simualtive in nature and were based on the standards and norms concerning the organization of work in plant production, parameters of the most commonly exploited combine harvesters on individual farms, mechanization services prices and theoretical and practical knowledge of the author (Lorencowicz, 2007).

The research material came from 96 deliberately selected individual farms located in 44 communes of Lower Silesia Voivodeship. These farms co-operated with the Lower Silesian Agricultural Advisory Centre in Wroclaw and were significantly bigger than the average units of this type located in Lower Silesia. The study was conducted in 2008-2010. Data were obtained during a questionnaire interview with landowners.

On the basis of these data two typological groups of combine harvesters were formed. Group selection was carried out taking into account the brands and models of combines and their basic operating parameters,such as strength, width and bandwidth threshing.

In each group the following brands and models corresponded to an average combine: group A – Bizon Z056; Group B – John Deere 1450 CWS. The unit costs of their operation, depending on the annual mixed use were calculated. Cost calculation was carried out using the methodology proposed by Muzalewski (2009). Depreciation costs were calculated in relation to the adopted 15-year lifetime. It was assumed that the period of use , longer than than the accepted one, will result in significant technical and moral use, which may affect the efficiency of mechanization on farms. Storage costs are assumed to be 0.5% of the purchase price and insurance costs of 0.1%. The intrest from the capital costs were skiped. The costs of repair were established with the use of ther repair costs index over the life of a combine. This ratio is assumed to be 40%, which is half the size given in the methodology presented by Muzalewski (2007, 2009). This value is consistent with the level recommended in the world literature (Calcante et al., 2013) and administered by OKL, KTBL and ART-Berichte by Muzalewski (2009). Operator costs were skipped assuming that the farmer does the work himself. Prices included in the calculations: fuel, harvest services (with shredding straw) and the purchase of harvesters were gross average prices for the period of 2008-2010 in accordance with farmers' indications during the interviews. The limit points balancing price of the service during working hours and the surface of acres to be harvested has been established. The limit points are synonymous with so much work of a machine per one year, at which the unit cost of operation is equal to the price of service. In this situation, the purchase of equipment is justified if it can be guaranteed that it is used not less than the limit (Muzalewski, 2003; Skwarcz, 2006). The maximum purchase price of a second-hand combine was estimated by setting a purchasing price if the following were known: the actual annual use and the unit cost of exploitation on the level of the service price.

Research results

The investigated farms had 57 combine harvesters. An average age of a combine was 22 years, with a coefficient of variation of 30%. Among these, only 13% of machines were purchased as brand new. On average, there were 1.71 combine per 100 ha, which was comparable to the national average and research in other research centers (GSO, 2011a; GSO, 2011b; Lorencowicz and Figurski, 2009). Distinguishing between typological groups

similar operating parameters of combines were taken into consideration. 51 combines were classified to two groups, 6 were rejected- they differed significantly from combines qualified to these groups and their parameters did not allow for creation of another homogeneous group. Division into typological groups with the basic parameters of combines was presented in table 1.

Table 1
Characteristics of typological groups of combine harvesters

Specification	Typological groups of combine harvesters	
	A Bizon Z056	B John Deere 1450 CWS
Number, (pieces)	46	5
Age, (years)	24	11
Work width, (m)	4.2	4.8
Power, (kW)	78	139
Performance W_{07}, ($ha \cdot h^{-1}$)	0.85	1.65

In order to calculate the border use a simulation of calculation of unit costs of operation at varying annual use was conducted. Actuarial calculation model was made in Excel, where according to the principle Ceteris Paribus, all parameters other than the annual use were maintained at aconstant level. This procedure is similar to the graphic method of determining the limit usage (Muzalewski, 2003). In order to calculate the unit costs of combines exploitation assumptions similar to those set out by Muzalewski were used in both groups (2009, 2010). Detailed assumptions are presented in Table 2.

Table 2
Assumptions for calculation of operating costs and limit points

Specification	Typological groups of combine harvesters	
	A	B
Life time, (years)	15	15
Fuel consumption, ($l \cdot h^{-1}$)	17	24
Ratio of repair costs, (%)	40	40
Parking costs, (% purchase price)	0.5	0.5
Fuel price, ($PLN \cdot l^{-1}$)	3.8	3.8
Costs of iunsurance, (% purchase price)	0.1	0.1
Purchase price, (PLN)	244, 000	402, 600
Harvesting service price, ($PLN \cdot ha^{-1}$)	300	300

Taking the combine service as a reference price it was proved that planning the purchase of a new combine, surface area for harvesting of cereals and plants which are technologically similar must be ensured at the following level: group A – 128 ha; Group B – 173 ha. Based on W_{07} combines operational efficiency in each group the limit number of hours of operation has been established (tab. 3, fig. 1 and 2).

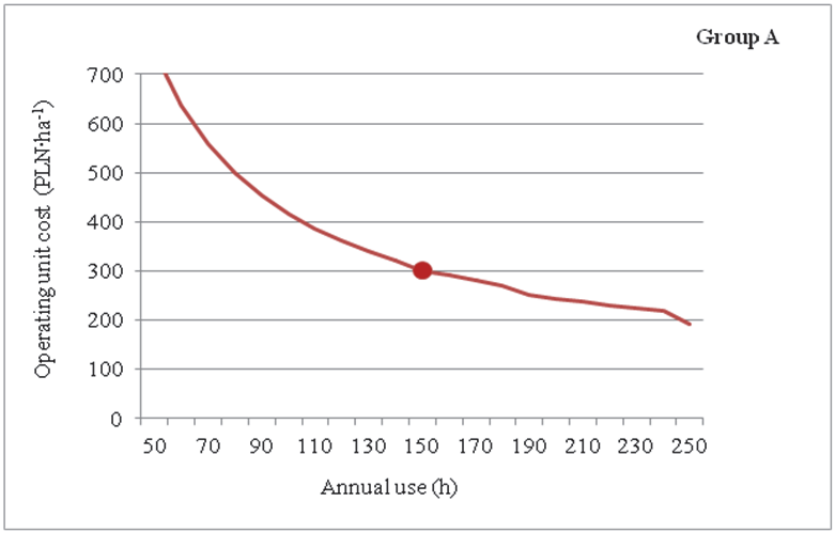

Figure 1.Limit point equalizing service price during working hours – group A

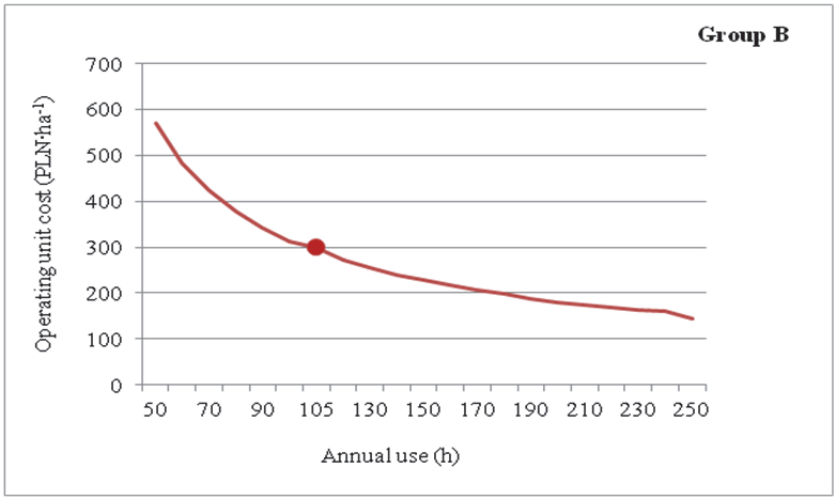

Figure 2. Limit point equalizing service price during working hours – group B

Table 3
Limit points equalizing service price during working hours and harvest acreage

Specification	Typological groups of combine harvesters	
	A	B
Hours, (h)	150	105
Area, (ha)	128	173

Limit values were compared to the surface area for harvesting in the farms under investigation. Only in five farms these values were exceeded approximately by 25% at the range of 4% to 59%. In four cases, farms owned harvesters from group A and in one case from group B. In the remaining 46 farms the harvesting surface was lower than the limited size at the average by 42% at the range of 9% to 92%. If this farms are planning to exchange existing combines while maintaining the current yield of production and the lack of activity in the form of a service of combine harvesting of cereals they should not decide to purchase a new machine. Much better solution would be for them to use the services. Similar conclusions are made by Muzalewski (2007) and Jablonka et al. (2010). In order to calculate the maximum purchase price of second-hand combines the simulation calculation of the purchase price at the following constant must be carried out: real annual use and operating unit cost price on the service price level. Time of utilization of the purchased combines has been set at 10 years. The remaining assumptions for calculations comply with data from table 2. Calculations show that if services are unavailable, farms can afford to buy used equipment for the average price, not exceeding for the farms posessing combines from group A – 89, 530 PLN, and for group B – 176, 315 PLN (tab. 4).

Table 4
Characteristics of use of combine harvesters in farms, limit points and limit prices

Specification	Typological groups of combine harvesters	
	A	B
Total harvested area, (ha)	53.00	104.16
Total services area, (ha)	10.24	10.20
Crop area – Total, (ha)	63.24	114.36
limit point, (ha)	128.00	173.00
% of yearly utilisation	49.41	66.10
Real annual use, (h)	74.40	69.31
Limit price of the used combine purchase, (PLN)	89, 530	176, 315

Conclusions

On the basis of the obtained results the following conclusions has been formulated:

1. The study showed that the purchase of a new combine will be rational only in those farms where there will be an area of cereal or technologically similar crops at the minimum level of 128 ha for group A and 173 ha for group B.

2. The established limit points based on the simulation were exceeded in four farms, which had harvesters from group A and in one from group B. In the remaining 46 farms the harvesting area was lower than the set limit size by an average of 42%.
3. The most rational form of mechanization in farms where the established points did not excede the limit points will be use of services or purchase of second-hand combine harvesters at a price not exceeding 89, 530 PLN for A group, and 176, 315 PLN for group B.

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WYKORZYSTANIE ROCZNE JAKO KRYTERIUM WYBORU FORMY UŻYTKOWANIA KOMBAJNU ZBOŻOWEGO

Streszczenie. Celem opracowania była próba naukowego rozstrzygnięcia alternatywy korzystania przez gospodarstwa z usług mechanizacyjnych w stosunku do zakupu nowego bądź używanego sprzętu technicznego na przykładzie kombajnów zbożowych. Utworzono 2 grupy typologiczne kombajnów zbożowych. W poszczególnych grupach odpowiednikami kombajnu przeciętnego były następujące marki i modele: A – Bizon Z056; B – John Deere 1450 CWS. Ustalono punkty graniczne równoważące cenę usługi w godzinach pracy i ha powierzchni przeznaczonej do zbioru. Badania wykazały, że zakup nowego kombajnu będzie racjonalny jedynie w tych gospodarstwach, gdzie zapewniony zostanie minimalny areał zbóż i roślin technologicznie podobnych na poziomie: grupa A – 128 ha; grupa B – 173 ha. W sytuacji braku dostępności do tych usług mogą sobie one pozwolić na zakup sprzętu używanego w przeciętnej cenie nie przekraczającej dla gospodarstw posiadających kombajny z grup A – 89530 PLN, i z grupy B – 176315 PLN.

Słowa kluczowe: gospodarstwo rolne, kombajn zbożowy, mechanizacja, usługa mechanizacyjna, województwo dolnośląskie