

## TRACTORS AND AGRICULTURAL MACHINERY MARKET IN UKRAINE IN THE YEARS 2010-2016

### Summary

The paper presents the results of analyses concerning the purchase of tractors and selected agricultural machines in Ukraine. In the analysed period, the decline in demand for mechanisation means in this country dominated. A significant increase in purchases was not observed until 2016. In the quantitative structure of purchases made by Ukrainian agricultural companies, agricultural tractors, cultivators and seeders have the largest share. A strong correlation was found between the number of machinery purchased and the income of the companies. On the other hand, the relation between the number of purchased tractors, combine harvesters and seeders per 100 agricultural enterprises, 10 000 ha of UAA (sown area) and 1000 machines used in enterprises and the average UAA of an average agricultural enterprise in Ukraine is poor.

**Key words:** agricultural tractor, agricultural machine, market, sales, purchases, demand, Ukraine

## RYNEK CIĄGNIKÓW I MASZYN ROLNICZYCH NA UKRAINIE W LATACH 2010-2016

### Streszczenie

Przedstawiono wyniki analiz dotyczących zakupów ciągników i wybranych maszyn rolniczych na Ukrainie. W analizowanym okresie dominował spadek popytu na środki mechanizacji w tym kraju. Znaczny wzrost zakupów odnotowano dopiero w 2016 r. W strukturze ilościowej zakupów dokonanych przez ukraińskie przedsiębiorstwa rolne największy udział stanowią ciągniki rolnicze, narzędzia uprawowe oraz siewniki. Stwierdzono bezpośredni związek pomiędzy liczbą zakupionych maszyn a dochodami przedsiębiorstw. Natomiast słabo zaznaczona jest zależność liczby zakupionych ciągników, kombajnów zbożowych oraz siewników w przeliczeniu na 100 przedsiębiorstw rolnych, 10 000 ha powierzchni UR (powierzchni zasiewów) oraz 1000 maszyn użytkowanych w przedsiębiorstwach a średnią powierzchnią UR przeciętnego przedsiębiorstwa rolnego na Ukrainie.

**Słowa kluczowe:** ciągnik rolniczy, maszyna rolnicza, rynek, sprzedaż, zakupy, popyt, Ukraina

### 1. Introduction

After Ukraine regained its independence, structural and systemic changes in its agriculture took place, resulting in the emergence of private agricultural enterprises and farms [3, 4]. With the establishment of new entities in agriculture in Ukraine, the market of mechanisation means has begun to develop. Due to its close proximity and significant production potential, Ukraine may be an attractive market for Polish producers of agricultural technology. The knowledge base of the agricultural technology market in Ukraine, contained in publications or studies published in the most accessible languages for Polish readers (Polish or English), including representatives of the Polish sector of agricultural machinery, is relatively poor. In the available resources on the Ukrainian market of mechanisation means one can find modest reports on the Internet and several publications by Ukrainian authors [2, 7].

Therefore, it is necessary to conduct research on the demand of agricultural tractors and machines in this country in order to broaden the scope of knowledge useful, first of all, for Polish agricultural machine manufacturers.

The aim of the study was to analyze changes in the market for agricultural tractors and machines in Ukraine. The time scope of the study was from 2010 to 2016 and, for the analyses of the purchase of new tractors and machines, the time scope was limited to the years 2011-2016 due to the availability of data. The analyses covered purchases of

tractors and the most characteristic agricultural machines for crop production included in the available statistical resources.

### 2. Source material and research methodology

The source material consisted of statistical data from the State Statistics Service of Ukraine (UKRSTAT). The scope of analyses covered purchases of selected mechanisation means (agricultural tractors, ploughs, harrows, cultivators, agricultural trailers, seeders, fertiliser spreaders and manure spreaders, machines for chemical and mechanical plant protection, tractor mowers, beet and potato combine harvesters, as well as self-propelled field choppers (in terms of quantity), demand for specific brands (of producers) and the power structure of the agricultural tractors. Due to the availability of data, the analyses took into account purchases made by agricultural enterprises, which include: agricultural associations, private enterprises, state farms, enterprises of other forms of farming and agricultural holdings. Due to the lack of statistical data, purchases made by households (family farms) were not included in the research.

Pearson's correlation (informing whether there is a relation between the two characteristics and the degree of this relation) was used to determine the relation between the number of tractors, ploughs, combine harvesters and seeders purchased by agricultural enterprises and the profit obtained by these entities in the previous year. Assuming a five-degree scale of dependency strength assessment (0-0.2 lack,

0.2-0.4 weak, 0.4-0.7 average, 0.7-0.9 strong, 0.9-1.0 very strong), the studied relationships were evaluated as weak, moderately strong or strong. In order to take into account the changes in the agrarian structure that are constantly taking place in Ukrainian agriculture, the number of agricultural tractors and selected two types of machines (seeders and combine harvesters) purchased in individual years of the analysed period was divided by the number of agricultural enterprises in the given years, the UAA (for seeders and combine harvesters, the total area sown for cereals, pulses, oilseeds and grain maize) and the number of machines of the type in use in the undertakings. Thus, the indicator of the number of purchased machines per 100 enterprises, per 10000 ha of UAA area (sown area) and per 1000 machines of a given type used in agriculture was obtained. Then, the relationships between the above mentioned ratios and the average area of UAA per one agricultural enterprise in particular years of the analysed period were determined. The equations are described using the polynomial function, thus determining the value of the matching factor  $R^2$ .

### 3. Research results

Sales of tractors and analyzed types of machines in Ukraine in the years 2010-2016 varied (Table 1). In 2011, a decrease in purchases of agricultural tractors, cultivators and trailers was noted in comparison to the previous year, while the demand for harrows, fertilizer and plant protection machines, combine harvesters and presses increased. The opposite trend was observed in 2012, when demand for agricultural tractors increased and decreased for combine harvesters, balers and harrows. Decrease of sales of most of the analysed machines was recorded in 2013 and 2014. The level of machine purchases in 2014 was the lowest in the analysed period. In 2016, there was a significant increase in demand for agricultural tractors and machines included in the analysis. Purchases of tractors and combine harvesters in 2016, compared to the previous year's level, increased by more than 40%.

Purchases of agricultural tractors and machinery depend to a large extent on the financial health of the agricultural enterprises. Analyses conducted using the Pearson correlation coefficient showed a relatively strong correlation between the number of agricultural tractors, ploughs and

seeders purchased and the profit achieved by Ukrainian agricultural companies in the previous year. The values of the Pearson correlation coefficient for the above mentioned dependencies were: 0.719, 0.779 and 0.849, respectively, while the average strength of the analysed dependency was found in the drop of combine harvesters. The value of Pearson's correlation coefficient for these machines was 0.601.

According to the analyses, the lowest purchases of mechanisation equipment in Ukraine in the analysed period took place in 2014. This may be related to the fact that in 2013 the profits of Ukrainian agricultural enterprises were half lower than in the previous year. The profitability of agricultural production has been halved as compared to 2012. Profitability of beef and poultry meat production in 2013 reached negative values, while that of pork was close to zero. A significant drop in profitability was recorded in the production of cereals, as well as rapeseed and sunflower [1]. The economic situation of agricultural enterprises in Ukraine improved in 2014 and 2015. According to data from UKRSTAT, the level of profitability of agricultural production in 2015 was the highest in 10 years, which translated into a significant increase in the income of enterprises [5]. The increase in incomes of agricultural enterprises contributed to the increase in demand for mechanisation means in 2016.

The number of purchased tractors and selected agricultural machinery in the years 2010-2016 and the profits of the companies from the previous year are presented in Fig. 1.

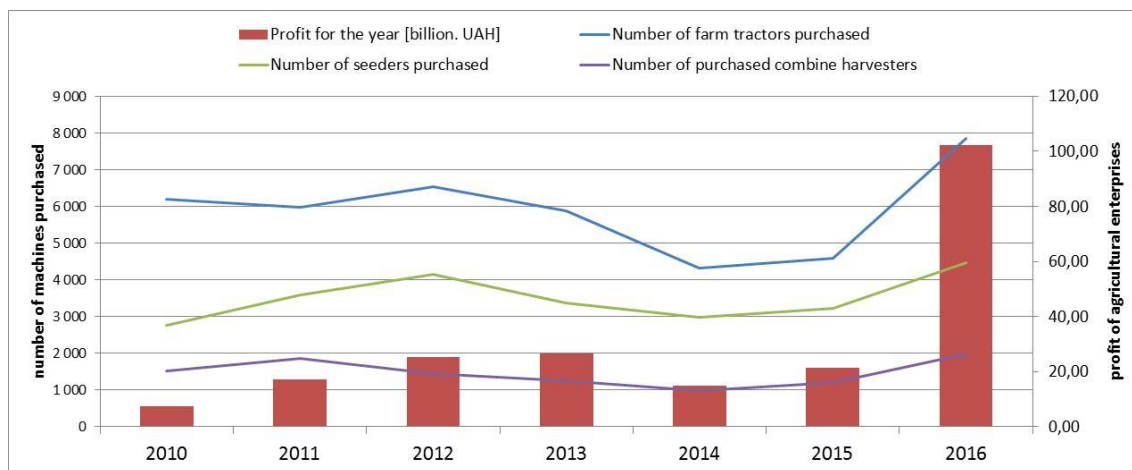
The structure of purchased tractors, both new and used, is dominated by vehicles with a power exceeding 60 kW. Between 2010 and 2016, Ukrainian agricultural companies acquired 32,409 agricultural tractors with power exceeding 60 kW, representing 78% of the total number of tractors purchased. In the segment of new tractors purchased in the years 2011-2016, the share of vehicles with a power exceeding 60 kW amounts to approx. 84%.

On average, new tractors accounted for about 46% of the total number of tractors purchased between 2011 and 2016, and in the period 2011-2016, the predominance of purchases of used tractors over new ones prevailed. The biggest difference between the number of new and used tractors purchased was in 2014, and the smallest in 2011 and 2016.

Table 1. Purchases of new and used tractors and selected agricultural machines in Ukraine in the years 2010-2016  
Tab. 1. Zakupy nowych i używanych ciągników oraz wybranych maszyn rolniczych na Ukrainie w latach 2010-2016

Type of machine	Purchases in year [pcs]						
	2010	2011	2012	2013	2014	2015	2016
Agricultural tractors	6 195	5 978	6 539	5 880	4 317	4 600	7 854
Agricultural trailers	1 835	948	931	791	683	556	989
Ploughs	1 136	2 261	2 246	2 118	1 799	2 136	3 141
Harrows	1 787	6 373	5 116	4 490	3 878	4 004	5 673
Cultivators	5 118	3 681	3 556	3 020	2 765	2 732	4 230
Seeders	2 757	3 599	4 155	3 359	2 984	3 235	4 474
Fertiliser spreaders and manure spreaders	1 230	1 506	1 361	1 447	1 185	1 137	1 803
Machinery for chemical and mechanical protection	1 018	1 489	1 468	1 443	1 180	1 186	1 803
Tractor mowers	534	585	619	488	423	324	560
Presses	475	807	619	652	484	452	535
Combine harvesters	1 513	1 855	1 448	1 245	974	1 200	1 984
Self-propelled field choppers	77	98	73	52	46	41	51
Potato harvesters	30	31	24	17	9	5	13
Beetroot harvesters	109	97	45	29	31	24	32

Source: / Źródło: UKRSTAT [6]



Source: own calculations based on UKRSTAT [5, 6]

Źródło: opracowanie własne na podstawie UKRSTAT [5, 6]

Fig. 1: Size of purchases of tractors and selected agricultural machinery in comparison with the profits of the companies from the previous year

Rys. 1. Wielkość zakupów ciągników i wybranych maszyn rolniczych w porównaniu z zyskami przedsiębiorstw z roku poprzedniego

The Ukrainian market offers tractors of both domestic manufacturers, which represent the Tractor Factory in Kharkiv (HTZ) and Slobbozanskaya Industrial Campaign (manufacturer of HTA series tractors), as well as foreign manufacturers, coming mainly from Western Europe and the USA but also from South-East Asia (China, Japan, Korea, etc.). In addition, there is an assembly plant of Minsk Tractor Factory (Belarus) in Ukraine, which supplies the market of this country tractors MTZ/Belarus brand.

In the group of new vehicles in the period 2011-2016, Belarusian/MTZ tractors constituted the largest number of purchased machines (11,281). The total share of this manufacturer in the sales of tractors in the analysed period amounted to 68%. Belarusian tractors were the most frequently purchased vehicles in the power range up to 100 kW. In the group of vehicles whose power exceeded 100 kW, in the analysed period Ukrainian companies purchased the most John Deere tractors (1583 units), followed by Case (896 units) and Belarus (869 units).

Between 2011 and 2016, Ukrainian agricultural companies purchased 3964 new combine harvesters. Foreign brands such as Claas, John Deere and Case dominated the purchasing structure. The total number of purchased com-

bine harvesters from these producers in the analysed period amounted to 1518 pieces. The significant share of Claas and John Deere in the purchase structure of combine harvesters is due to the high demand for these machines in the years 2010-2013, and in 2016 there was a significant drop in demand for combine harvesters from these manufacturers, with an increase in purchases of Case IH and Fendt brands.

The analyses showed that the number of purchased agricultural tractors, combine harvesters and seeders, both per 100 agricultural enterprises and per 10 000 ha of UAA (in the case of combine harvesters and seeders per 10 000 ha of sown area) and 1000 machines used in enterprises reached the lowest value in 2014. The reason of this lied in the low sales of these machines in 2014. A significant increase in demand for agricultural technology in 2016 contributed to an increase in the value of the analysed indices. The ratio of the number of purchased agricultural tractors, combine harvesters and seeders per 1000 used machines in enterprises in 2016 was much higher than in the previous year despite the decrease in the number of used machines in enterprises. The indices characterising purchases of tractors, combine harvesters and seeders in Ukraine in the years 2010-2016 are presented in Table 2.

Table 2: Indicators characterising purchases of tractors, combine harvesters and seed drills in Ukraine in the years 2010-2016

Tab. 2. Wskaźniki charakteryzujące zakupy ciągników, kombajnów zbożowych i siewników na Ukrainie w latach 2010-2016

Farm tractors							
	2010	2011	2012	2013	2014	2015	2016
Number of tractors purchased /100 enterprises	11,0	10,6	13,2	12,0	9,3	10,1	16,5
Number of tractors purchased /10000 ha UAA	2,9	2,8	3,0	2,7	2,0	2,3	4,0
Number of tractors purchased/1000 for use in enterprises	40,9	40,6	43,4	40,3	33,0	36,0	61,1
Combine harvesters							
Number of purchased combine harvesters/100 enterprises	2,7	3,3	2,9	2,5	2,1	2,6	4,2
Number of purchased combine harvesters/10000 ha of cereal, oilseed and grain maize crops	0,72	0,83	0,64	0,53	0,43	0,53	0,87
Number of purchased combine harvesters/1000 in enterprises	46,2	57,9	45,3	41,4	35,8	44,9	72,5
Seeders							
Number of seed drills purchased/100 enterprises	4,9	6,4	8,4	6,8	6,5	7,1	9,4
Number of seed drills purchased/10000 ha cereals, oilseeds and grain maize	1,32	1,60	1,83	1,42	1,31	1,43	1,96
Number of purchased seed drills/1000 of seed drills used in enterprises	38,1	50,5	57,0	47,2	45,5	49,4	66,6

Source: own calculations based on UKRSTAT [5, 6]

Źródło: opracowanie własne na podstawie UKRSTAT [5, 6]

Table 3. Function describing the relation between indicators of number of purchased tractors, combine harvesters and seeders depending on the average UAA

Tab. 3. Postaci funkcji opisujących zależność pomiędzy wskaźnikami liczby zakupionych ciągników, kombajnów zbożowych i siewników w zależności od średniej powierzchni UR

<b>Farm tractors</b>			
	Number of tractors purchased /100 enterprises	Number of tractors purchased /100 enterprises	Number of tractors purchased /100 enterprises
Function describing the relation between the above indicator and the average UAA area	$y = -0,3344x^2 + 2,482x + 8,58748$	$y = -0,0679x^2 + 0,4099x + 2,5172$	$y = -1,0442x^2 + 6,8427x + 35,707$
Matching factor $R^2$	$R^2 = 0,301$	$R^2 = 0,387$	$R^2 = 0,316$
<b>Combine harvesters</b>			
	Number of purchased combine harvesters/100 enterprises	Number of purchased combine harvesters/100 enterprises	Number of purchased combine harvesters/100 enterprises
Function describing the relation between the above indicator and the average UAA area	$y = -0,0942x^2 + 0,5941x + 2,4172$	$y = -0,0106x^2 + 0,0235x + 0,7663$	$y = -1,4611x^2 + 8,422x + 44,638$
Matching factor $R^2$	$R^2 = 0,556$	$R^2 = 0,697$	$R^2 = 0,529$
<b>Seeders</b>			
	Number of seed drills purchased/100 enterprises	Number of seed drills purchased/100 enterprises	Number of seed drills purchased/100 enterprises
Function describing the relation between the above indicator and the average UAA area	$y = -0,2998x^2 + 2,5642x + 2,8134$	$y = -0,0047x^2 + 0,3577x + 1,0617$	$y = -1,7933x^2 + 14,562x + 28,242$
Matching factor $R^2$	$R^2 = 0,650$	$R^2 = 0,491$	$R^2 = 0,550$

Source: own calculations based on UKRSTAT [5, 6]

Źródło: opracowanie własne na podstawie UKRSTAT [5, 6]

On the basis of the conducted analyses, no strong correlation was found between the number of purchased agricultural tractors, combine harvesters and seeders per 100 agricultural enterprises, 10 000 ha of UAA (sown area) and 1000 machines used in enterprises and the average UAA of an average agricultural enterprise in Ukraine in particular years of the analysed period. Moreover, it was found that the functions describing the relation between the analysed values are negative. The lack of detailed statistical data concerning the sale of tractors and machines on a regional basis does not allow for explanation of the reason of this situation. It can be assumed that the demand for mechanisation means in quantitative terms is to a greater extent generated by smaller enterprises, including agricultural holdings, which dominate the agrarian structure of Ukrainian agriculture. Hence, there is no positive correlation between the average size of the company and the number of mechanisation means purchased.

The obtained forms of polynomial functions describing the relationships are presented in Table 3.

#### 4. Summary

The tractor and machine market in Ukraine in the analysed period was characterised by fluctuations in demand, largely related to the financial condition of agricultural enterprises, resulting from the situation on the agricultural crop markets. Between 2012 and 2014, Ukraine saw a decline in purchases of most of the mechanisation means included in the analysis. The increase in the purchase of tractors and machines was recorded in the years 2015-2016, and the analysis of the changes in the demand for mechanisation means has shown that they are closely related to the

income obtained by enterprises from agricultural production. In the analysed period, there were changes in the values of indicators expressing the number of purchased tractors, combine harvesters and seeders per 100 agricultural enterprises, 10 000 ha of UAA (sown area) and 1000 machines used in enterprises. On the other hand, no strong correlation was found between the above mentioned ratios and the average UAA of an average Ukrainian agricultural enterprise in particular years of the analysed period.

#### 5. References

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