

REGIONAL DIFFERENTIATION OF THE POWER OF AGRICULTURAL TRACTORS PURCHASED IN POLAND IN THE YEARS 2006-2013

Summary

It has been shown, that during the investigated period of 2006-2013 in all analyzed regions of Poland: north-west, south-west, north-east and south-east, the majority of purchased tractors was in the power group of: 75-90 and 90-118 kW and, approximately, about half fewer within the groups of power 75-90 and 90-118 kW. However, in the Western Poland, especially in the south-east region, much more new and used tractors with the power 18-75 kW were purchased. Generally, in all regions purchases concerned more of used tractors rather than new ones in the group of power 37-59 kW, on the other hand, much more of new tractors than used ones were purchased in the group of power 59-75 kW. The total power of the implemented tractors for usage was the highest in the south-east region, at the lowest equivalent average power of an individual tractor. It has been shown, that during the years 2006-2013 there was a moderate upward trend of the average equivalent power of tractors, purchased only in the regions of lowest power saturation – i.e. in the south-west and north-east regions.

Key words: new agricultural tractors, used agricultural tractors, purchased, engine power, Poland, regions

REGIONALNE ZRÓŻNICOWANIE MOCY CIĄGNIKÓW ROLNICZYCH ZAKUPIONYCH W POLSCE W LATACH 2006-2013

Streszczenie

Wykazano ogólnie, że w badanym okresie 2006-2013 we wszystkich analizowanych regionach Polski: północno-zachodnim, południowo-zachodnim, północno-wschodnim i południowo-wschodnim, najczęściej ciągników zakupiono w grupach mocy 37-59 kW i 59-75 kW oraz o około połowę mniej w grupach mocy 75-90 i 90-118 kW. Jednak w Polsce Zachodniej, a zwłaszcza w regionie południowo-wschodnim, nabyto znacznie więcej ciągników nowych i używanych o mocy 18-75 kW. Ogólnie we wszystkich regionach zakupiono znacznie więcej ciągników używanych niż nowych w grupie mocy 37-59 kW, natomiast znacznie więcej ciągników nowych niż używanych w grupie mocy 59-75 kW. Suma mocy zakupionych ciągników była największa w regionie południowo-wschodnim przy najmniejszej ekwiwalentnej mocy średniej umownego ciągnika. W latach 2006-2013 wykazano nieduży (umiarkowany) trend wzrostowy ekwiwalentnej mocy średniej ciągników wprowadzanych do użytkowania tylko w regionach o najmniejszym nasyceniu mocą, tj. w regionie południowo-zachodnim i północno-wschodnim.

Słowa kluczowe: ciągniki rolnicze nowe, ciągniki rolnicze używane, zakupy, moc silnika, Polska, regiony

1. Introduction

Agricultural tractors are the source of power, essential for work with many other tools and machines. They are used mostly in agriculture, but also mainly in transport, by municipal firms and in road building. One can observe different demand for wide range of agricultural tractors in the country, dependent on economically diversified regions. This causes difficulties with efficient management of tractor trade and aftersales service, and requires permanent analysis of the market as well as of the country's tractors purchases state.

During the market research, performed based on the source data from the Central Statistical Office (GUS) and the European Statistical System (EUROSTAT), an analysis of the production of new agricultural tractors as well as the import and export of used tractors in Poland up to the year 2010 was performed [5, 6, 7, 9, 11]. A more exact analysis of new and used tractors and their power, purchased across Poland in the years between 2006-2013, was made on the basis of the data of their first registration in Central Vehicle and Driver Register (CEPiK) [1].

Few researches concern regional market of agricultural tractors. On the basis of General Agricultural Census, it was proven that in the period 2002-2010 purchases of new agricultural tractors in the provinces of Poland, varied from 3 up to even 8 times [8]. It was generally found, that most tractors were purchased in the group of power 60-100 kW, a little less with the power 40-60 kW and >100 kW. What is more, it was stated, that purchases in these groups of power differed between provinces several times. It was indicated in this context, that results of those analysis are vitiated by an error because these analysis researches did not include tractors which were purchased outside of the farming sector and those used on the aftermarket. The latest research results concern the purchases of new and used agricultural tractors in four regions of Poland, but they do not include the analysis of the tractors' power structure [2, 3].

Aforementioned shortcomings of current knowledge concerning the power of purchased agricultural tractors in the regions of the country were the reason for the researches presented in herein work. This subject area is especially important in the context of evaluation of expected results concerning significant subsidizing of agriculture under the

Agricultural Development Support Program 2007-2013 (PROW 2007-2013) [10].

The main goal of herein work was to identify and analyze the power of new and used agricultural tractors, purchased in the period from 2006 up to 2013 in the regions of Poland. This goal was realized for the north-west, south-west, north-east and south-east regions, sectioned off for the research purposes [2, 3].

2. Material and methods

For the purpose of this work the engine power structure of new and used agricultural tractors purchased in the analyzed regions of Poland in the years 2006-2013 has been identified and analyzed. Also, a research has been conducted on the power saturation in particular regions and the dynamics of power saturation changes in consecutive years – from 2006 to 2013.

Source data were derived from CEPIK, an informatics database comprehensive and credible data starting from the year 2006. An analysis has also been made on the agricultural tractors registered for the first time in Poland, therefore implemented for usage for the first time [1]. According to the analysis performed by Błaszkiwicz et al. [3] the CEPIK data show more accurate numbers of purchased tractors than the data from GUS and EUROSTAT.

For the purpose of this work an analysis has been performed of new agricultural tractors, used ones as well as both categories jointly. New tractors were recognized as produced in the year of their registration and the year before, whereas used tractors were recognized as produced at least two years prior to registration. The analysis involves groups of tractors powers, accepted in the literature: <18, 18-37, 37-59, 59-75, 75-90, > 90 kW [1, 2, 6, 7, 8, 11]. For the purpose of getting additional knowledge about the tractor powers ≥ 90 kW, which are seen more often on the Polish market, two groups of power were sectioned of: 90-118 and >118 kW.

Tractors power saturation indicates obtainable energy, necessary for the realization of many production processes, and is an important parameter that characterizes potential

development opportunities of regions in Poland. In this work, power saturation has been characterized by two indicators: sum of tractors powers P_s [MW] and average power of equivalent tractor [kW]. Sum of tractors powers P_s is an algebraic sum of tractors powers concerning all agricultural tractors purchased in a given region between 2006 and 2013. Average power of equivalent tractor in the region P_{sr} is a quotient of P_s indicator and the number of tractors in the region. Those indicators allow for simplified but easy comparing of tractors powers in the regions.

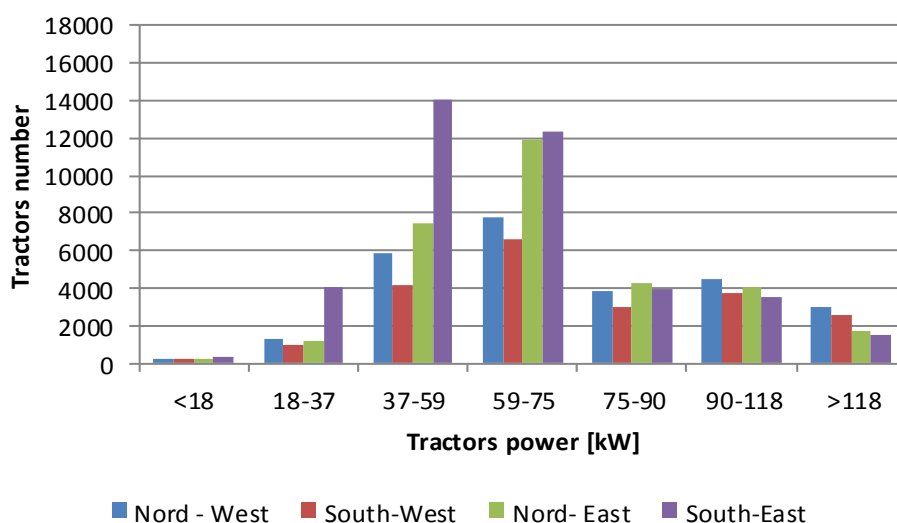
For the purpose of hereby paper, the administrative map of Poland was divided on the basis of economic diversity and marketing objectives into four regions (north-west, south-west, north-east, south-east), according to the scheme shown in the previously work (3).

3. Results and discussion

Power structure of new and used agricultural tractors

Based on the data shown in Fig. 1, 2 and 3, an analysis has been performed on the agricultural tractors within the groups of their powers, purchased in the regions of Poland from 2006 to 2013. These figures present previously developed partial research results for the north-west region, for the purpose of comparative analysis of four regions of Poland [2]. This data show that the number of purchased tractors in analyzed groups of power is generally alike in all regions of Poland. During the investigated period of 2006-2013 in all regions the largest number of tractors was purchased in the group of power 37-75 kW, about 30-50% less with the power 75-90 and 90-118 kW, and only a little less in the groups of highest power >118 kW and the lowest power 18-37 kW.

However, there are some quantitative differences within the power structure of new and used tractors. The analysis in Fig. 1 shows, that in all regions the largest number of new tractors was purchased in the group of power 59-75 kW – approx. 7000-9000 units; approx. 30% less in the group of power 37-59 kW (6000-7000 units on average) and significantly less in higher groups of power 75-90 and 90-118 kW (3000-4000 units on average).



Elaborated on the basis of CEPIK data / Opracowano na podstawie danych CEPIK

Fig. 1. Power groups of new agricultural tractors purchased in analyzed regions of Poland between 2006 and 2013

Rys. 1. Grupy mocy nowych ciągników rolniczych zakupionych w analizowanych regionach Polski w latach 2006-2013

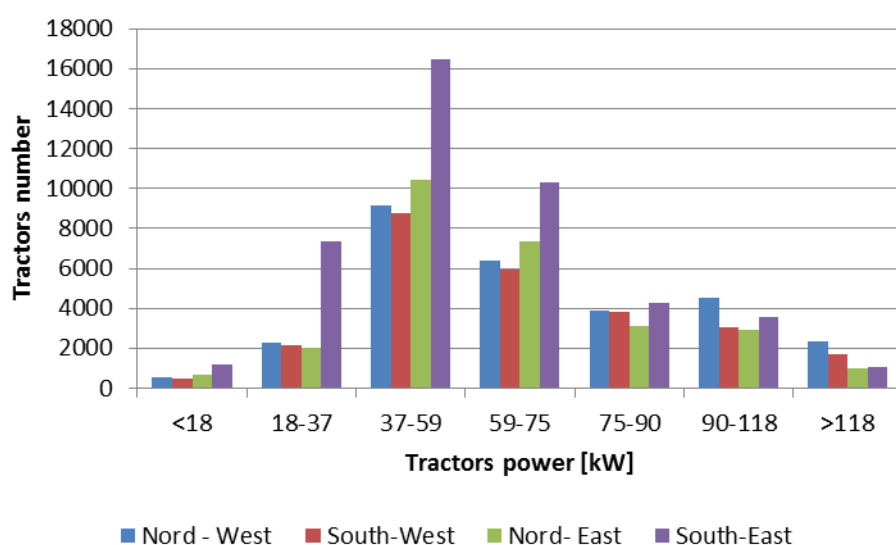
In the south-east region almost doubled number of tractors was purchased in the groups of lower power: 18-37 and 37-59 kW than in other regions. In above region, as well as in the north-east region, much more new tractors arrived in the group of power 59-75 kW.

In all regions of Poland the most used tractors were purchased with the power 37-59 kW – in the range of 8000-12000 units, and about 30% less with the power 59-75 kW – in the range of 6000-8000 units (Fig. 2). For about half less used tractors arrived with higher powers 75-90 and 90-118 kW, in the range of 3000-4000 units. Only in the south-east region purchases concerned much more used tractors of lower powers 18-75 kW, and especially with the power 18-37 kW.

One can generalize, that in all regions overall power structure of used tractors is quite different from overall

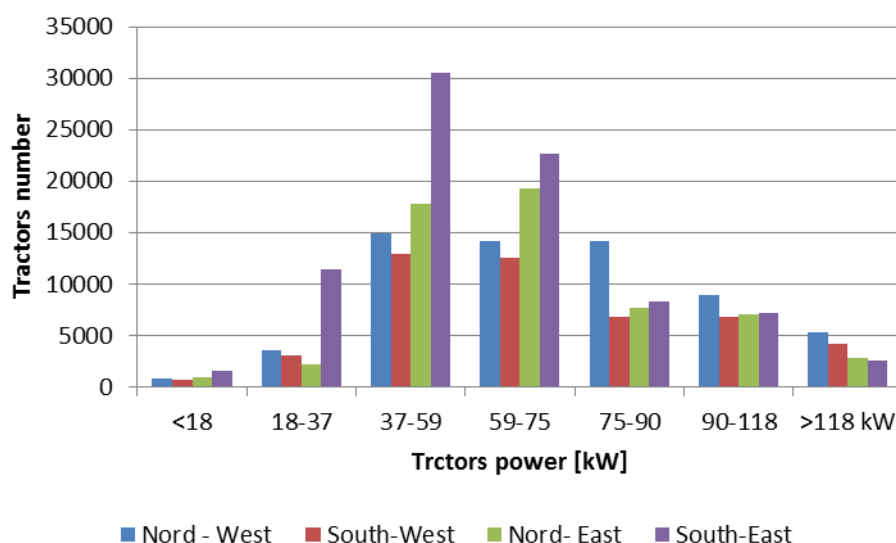
power structure of new units, mostly in the range of average powers 37-75 kW. Much more new tractors with the powers 59-75 kW were purchased than the used ones, whereas in the group 37-59 kW, much more used tractors than the new ones were purchased. The above statement is an elaboration of a general observation of the authors presented in the other publication [3], which stated that in the regions of Poland the number of new tractors purchased was higher than the number of used units by approx. 15% to 30%.

Analysis of the overall number of purchased tractors (total of new and used), shows in all regions most tractors on the similar level – 13000-17000 units, in the groups of power 37-59 kW and 59-75 kW (Fig. 3). About half fewer were purchased in the groups of power 75-90 and 90-118 kW – about 7000 in each.



Elaborated on the basis of CEPiK data / Opracowano na podstawie danych CEPiK

Fig. 2. Used agricultural tractors in the groups of power purchased in analyzed regions of Poland between 2006 and 2013
Rys. 2. Grupy mocy używanych ciągników rolniczych zakupionych w analizowanych regionach Polski w latach 2006-2013



Elaborated on the basis of CEPiK data / Opracowano na podstawie danych CEPiK

Fig. 3. Agricultural tractors in the groups of power (new and used ones jointly), purchased in the regions of Poland between 2006 and 2013

Rys. 3. Grupy mocy ciągników rolniczych (nowe i używane łącznie), zakupionych w analizowanych regionach Polski między 2006 a 2013 rokiem

Higher level of purchases of new and used tractors in the south-east region, proven previously, influenced this region with generally 100% higher purchases of agricultural tractors with the power 37-59 kW and 30% higher purchases of those with the power 59-75 kW. It is worth pointing out, that in this region, four times more tractors were purchased with the power 18-37 kW than in all other regions. One can state, that higher demand for low-power tractors, present in the south-east region, results mostly from significantly smaller average size farm area, on average 5.9 ha, and lower farmers' income in comparison with other regions of Poland [4]. Average area of farms amounts to 15.6 ha in the north-west region, about 9.9 ha in the south-west region and 13.2 ha in the north-east region.

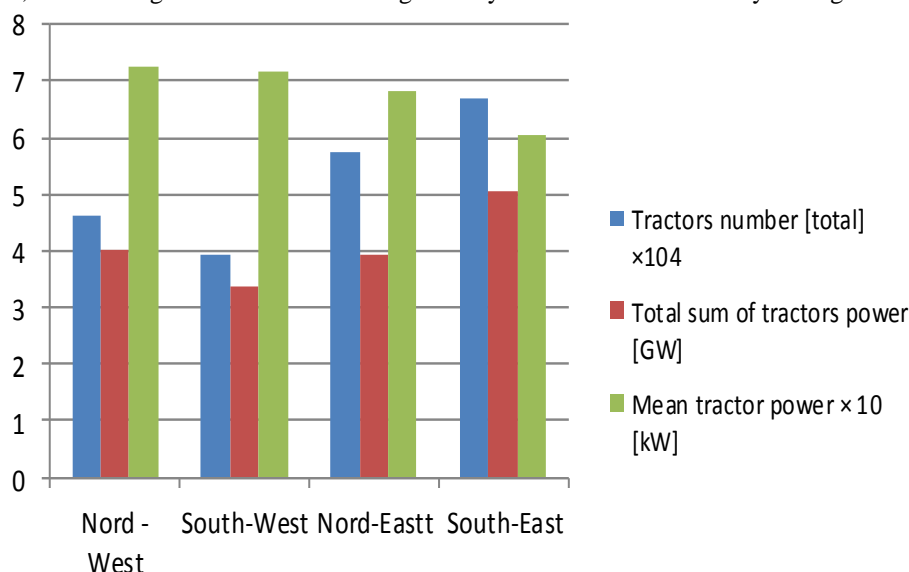
Furthermore, it is worth to emphasize, that in north-west region one can observe purchases of higher number of tractors with power above 90 kW (90-118 and > 118 kW). It is fully understandable, considering that the farms of largest

area are situated in this region, and they require more efficient agricultural machines and tractors with higher power.

Saturation with tractor powers in regions between 2006 and 2013 and dynamics of power saturation changes in consecutive years

Regional power saturation of tractors, purchased between 2006 and 2013 can be evaluated on the basis of the research results presented in the Fig. 4. This data shows, that the summarized tractors power purchased in the south-east region amounts to about 5 GW and is higher than in the remaining regions of Poland where it amounts to 3.4 to 4 GW. One can assume that the highest purchased power in the south-east region results from, proved previously, higher than in the other regions number of tractors in the groups of powers characterized by very high demand in the range 18-75 kW (Fig. 3 and 4).

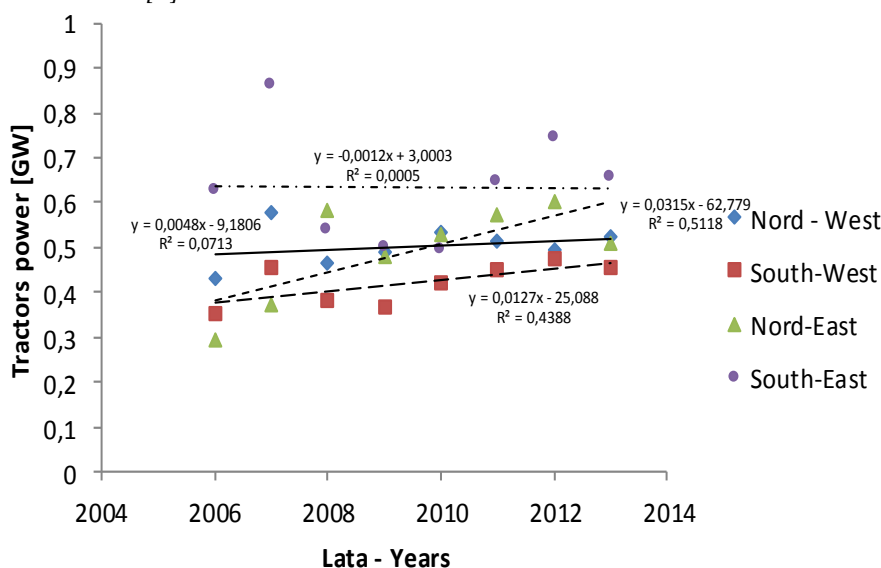
Dynamics of purchased tractor power in consecutive years differed in the analyzed regions of Poland (Fig. 5).



Elaborated on the basis of CEPiK data / Opracowano na podstawie danych CEPiK

Fig. 4. Tractors powers sum, average power of equivalent tractors and the number of tractors together, in investigated regions of Poland between 2006 and 2013 [3]

Rys. 4. Suma mocy ciągników, średnia ekwiwalentna moc ciągników oraz liczba ciągników razem, w badanych regionach Polski między 2006 a 2013 rokiem [3]



Elaborated on the basis of CEPiK data / Opracowano na podstawie danych CEPiK

Fig. 5. Summary power of agricultural tractors purchased in analyzed the regions of Poland in consecutive years from 2006 to 2013

Rys. 5. Zbiorcza moc ciągników rolniczych zakupionych w analizowanych regionach Polski kolejno od 2006 do 2013 roku

The amount of purchased power in the north-west and south-east regions, regardless of periodic fluctuations, is in the entire period quite constant. The horizontal trend, presented in Fig. 5, is characterized by coefficients of determination of $R^2=0.0713$ and $R^2=0.0005$ respectively. Whereas, in the south-west region ($R^2=0.4388$) and north-east ($R^2=0.5118$) in the years 2006-2013, a moderate increase in purchased powers appeared, characterized with averagely strong trend. One can assume, that the above increase in tractors purchases resulted from a low agricultural tractor power saturation in these regions (Fig. 4).

A general comparison of powers concerning tractors purchased in the analyzed regions can be also made on the basis of average power of an equivalent tractor (Fig. 4). This value in the south-east region amounts to 60 kW and is significantly lower than the power of 68-72 kW in three other regions of Poland. It is believed, that the lower value of this power in the aforementioned region, results from significantly higher than in other regions number of purchased tractors (Fig. 4) with the lower engine powers of 18-37 and 37-54 kW (Fig. 3).

4. Conclusions

Based on the analysis of the research results of engines powers of used tractors in the period of 2006-2013 in all regions of Poland: north-west, south-west, north-east and south-east, performed on the basis of data of their first registration in Central Vehicle and Driver Register (CEPiK), the following was concluded:

1. In all regions of Poland, generally the number of tractors purchased with the engine powers of 37-59 kW and 59-75 kW was the highest, whereas, half this number were tractors in the power group of 75-90 and 90-118 kW.
2. In the Eastern Poland, especially in the south-east region, much more of new and used tractors were purchased in the groups of powers within the range 18-75 kW, than in Western Poland.
3. It was generally proven, that in analyzed regions much more new tractors than used ones were purchased in the groups of power 59-75 kW, whereas in the group of power 37-59 kW, much more used tractors than the new ones.
4. During the investigated period in south-east region the sum of purchased power of tractors amounted to 5 GW and was significantly higher than in remaining regions of Poland. The power of equivalent tractor in this region amounted to approx. 60 kW and was generally lower by

about 16% than the power in the remaining regions.

5. A moderate increase in aggregate tractors powers in consecutive years was proven, but only in the regions with less power saturation, i.e. in the south-west and north-east regions.
6. The highest sum of powers and the lowest average tractors power in the south-east region result from decidedly higher number of purchased tractors with lower powers.

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