

Regional differences in equipment of machinery park on farms

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S u m m a r y. The aim of this paper was to analyze the level of machinery park equipment on the farms differing in their location. In the course of research carried out in the form of directed interview, the objects were chosen from the Małopolska Province and the West Pomerania Province. The obtained results allow for the conclusion that in the case of the surveyed holdings, there are differences in the level of machinery park equipment. Examples include value of installed capacity in tractors, where for the objects of the Małopolska Province is the average of $9.05 \text{ kW} \cdot \text{ha}^{-1}$ of cropland, while in the West Pomerania Province only $1.99 \text{ kW} \cdot \text{ha}^{-1}$ of cropland.

Key words: agricultural machinery, tractors, machinery park, farm.

INTRODUCTION

One of the factors determining the competitive ability of Polish agriculture is the use of cost-effective production technology. The possibility of applying such technology forces the necessity of machinery park renewal, especially in commodity holdings, which will allow to obtain a better quality of products [14, 5]. Thus, the use of technical means of work in addition to improving the working conditions of the farmer and reducing the workload of manual should also have an impact on getting better production effects [Kocira 2008]. Obtaining a good quality of products enforces compliance with various standards, standardized national rules and EU regulations. By a set of technology standards, we mean a set of requirements and technological parameters, which include technical and technological equipment, functional solutions, the elements of technical infrastructure to meet the needs of animal welfare, but also protecting the environment. These standards relate to for eg. design, construction and maintenance of livestock buildings, installation, operation and control of animals, machinery and equipment used in the production and transport of animals [11]. So now the choice of individual elements of technical infrastructure of farms on the one

hand is dictated by the needs resulting, among others, from the orientation of production, on the other hand, it must meet the relevant requirements in order to comply with standards. Undoubtedly, a reasonably sized and operated tractor-machine park improves production operations in accordance with the requirements of agrotechnical periods of agronomy and quality of treatments, and its costs are not borne by the holding over the current playback capabilities of existing hardware [13]. Known and used methods of selection of machines and machinery for farms (e.g. indicator, technological or factor) are quantitative methods that allow you to specify the number of units needed due to the agricultural area, crop structure and the term of agrotechnical and complex system of technological processes [3]. Another of the factors that are determinant of equipment level of the machinery park is the intensity of production. It may be one of the determinants of the changes taking place in the farm aimed towards the modernization of technical base [18]. The precision agriculture should also be mentioned, whose implementation can not do without the input of new solutions in the field of agricultural technology. Practical applications of precision agriculture require different applications of the doses of fertilizers, pesticides, seeds, or changes in equipment operating parameters (e.g. depth of plowing, sowing density, performance of air flow in the sprayers) [16]. The key of importance in improving food security will be played by the monitoring system (traceability) at each stage of production, processing and trade, which cannot be made without the use of precision agriculture components [Auerhammer 2006]. Monitoring is necessary, particularly to identify the time and place of contamination of plant protection products by nitrates and heavy metals, or use of illicit substances [6]. For this purpose it is necessary to correlate the positioning and communication system. So there is a problem of significantly wider agricultural information in the introduced process of modernization of

the machinery park, because on the quantity and quality of the gained information the management of the farm production process depends. Decisions regarding the purchase or sale of agricultural machinery, significantly affect the production technologies and, consequently, the economic health of the holding (agro firm) in the future [2].

Analysis of supply of selected agricultural machinery and equipment for the domestic market in the years 2001-2009 showed that, similarly to the production, import and export, it is characterized by high volatility, which certainly does not favor domestic producers in the planning of production [20]. Significant changes are observed in the production and distribution of agricultural machinery and methods of their manufacture and use. Currently, the final product usually arises from the assembly of finished parts ordered from subcontractors or purchased from specialized companies. In the production and trade, apart from the transnational corporations the important role is played by small and medium enterprises (SMEs) producing these accessories or short series of very specialized machines [Hołownicki 2008]. These dependencies are the result of many conditions. These will include factors related to the regionalization of agricultural production and, in relation to them, the size of economic and operational indicators [7]. Polish agriculture is characterized by a great diversity of farming conditions. This is evident in the wide range of agrarian structures and the considerable variations in the size of farms as well as livestock. Also, a significant influence on the specificity of Polish agriculture is undoubtedly exerted by geographical conditions, which to some extent limits the extent of the agricultural production. The level and structure of production are often determined by the experience possessed by the farmer and farm equipment in the technical appliances [17]. Taking into account the current situation of Polish agriculture, the number of family farms should be increased so that they gave full employment to at least 2 family members and sufficient parity income for agricultural families. Due to the development of mechanization, the transformation of agrarian sector is desirable, in the direction of the growing area of farms [7]. As numerous studies by other authors have pointed out [21, 15, 19, 12], the equipment of households in agricultural equipment, including the number, types, value and efficiency of machines and the number of used tractors and their power varies widely

between farms, even of a similar production profile. The most differentiating factor, in terms of the mechanical appliances, is undoubtedly the size (area) of the farm. It is a major distinguishing feature of the scale of production. Specific features of agricultural production – i.e. the spatial nature, seasonality, diversity of products obtained, the quality of agricultural roads and the other - require that the farm is equipped in diverse and sometimes specialized technical means, e.g. for transport [9]. Efficiency of raw material and transport flows in the enterprises depends to a major extent on the proper equipment of farms in the technical means in the form of production and transport equipment, which are part of the logistics infrastructure [10].

The conducted study of literature in the field on the issues concerning the modernization of technical equipment of farms raises the question, whether the existing regional disparities in our country are also reflected in the level of technical equipment in facilities of farms? Therefore, can the available resources of land be the determinant of the quantitative status of ownership of agricultural machinery and tools? Are the resources invested in the machinery park comparable in two distant voivodships? Finding the answer to the above questions was undertaken as the objective of this work.

MATERIALS AND METHODS

To fully accomplish the adopted objective of the work, the target objects were selected from two distant sites: the Małopolska Province and the West Pomerania Province, these regions being undoubtedly different as to the nature of the conducted agricultural activities. The characteristics of technical equipment was based on background information gathered during research conducted in the form of directed interview with the owners of farms, using a previously prepared questionnaire. The study was conducted in 30 farms, with 15 objects from each of the voivodships. In addition to the grouping variable, which was the location, the farms were also divided according to the area. By creating various area groups comparing the size of each, in the two voivodships only two groups were separated, i.e. 5,1-15,0 ha and 15,1-30,0 ha.

In the studied objects the pattern of use was dominated by arable land and conducted agricultural activi-

Table 1. Characteristics of the surveyed holdings

Specification	Farms							
	Małopolska Province				West Pomerania Province			
	including area [ha]:							
	Average	0-5,0	5,1-15,0	15,1-30,0	Average	5,1-15,0	15,1-30,0	30,1-50,0
Number of holdings	-	4	7	4	-	4	6	5
Area of agricultural land [ha]	11,40	3,85	10,71	20,14	52,83	14,13	23,75	119,20
Arable land	10,96	3,21	10,41	19,67	46,66	11,50	12,42	109,20
Grassland	0,43	0,63	0,30	0,48	6,17	1,63	4,33	12,00

[Source: own research]

ties were focused on plant production (Table 1). The characteristics of the tractor-machines park working in the surveyed farms is shown by calculating: quantitative equipment of the owned technical equipment, replacement value of machinery park, the rate of energy consumption and the performance of agricultural tractors (by giving the number, age, duration of use, annual use). Calculations were based on the methodology used in the Institute of Agricultural Engineering and Informatics at the Faculty of Production and Power Engineering, University of Agriculture in Krakow [8].

THE RESULTS AND DISCUSSION

One of the key pieces of equipment of the machinery park is mechanical traction, i.e. tractors. In the group used for comparative analysis, the quantitative average of equipment in tractors was comparable, i.e. at the level of about 2 pcs · farm⁻¹. Referring the number of tractors to the conversion factor of one hectare from the area of agricultural land, we see that these differences are important. In the group of objects from the West Pomerania Province, on average there were only 0.04 units per hectare, while in the second group there were 0.33 pc. Noticeable difference is also evident within the first adopted area group (5,1-15,0 ha of agricultural land), where, in the farms from the West Pomerania Province, the value is less than 10-fold. By analyzing the owned tractors by the classes, in each case they were dominated by tractors in class 9 kN (Table 2).

One of the characteristics of agricultural tractors, speaking indirectly about their „modernity”, is their age. In the surveyed holdings, the average age in both the West Pomerania Province and the Małopolska Province was decreasing while increasing the area of agricultural land. Analyzing the average value, the younger tractors were owned by farmers from the West Pomerania Province, for an average of 4 years. The difference in the average level of four years was also noted in the analysis of time of use of farm tractors. It should be noted that the average age of tractors often is underestimated by the dominant number of tractors owned which were more than 15 years old, but in the whole group of tractors in the farms reported, the present „new” (1-5 years old) tractors were often purchased from the EU funds.

Proper selection of tractors should be reflected in the level of their annual usage. It is a indicator of the use of their productive potential, which indicates the degree of utilization of the merits of having these machines. In the analysis, the annual use of agricultural tractors was related to the area of one hectare of agricultural land, farm, and physical piece of tractor. Comparing the annual use of tractors in relation to the available resources of land, we can see that the households of the Małopolska Province with an increase in available resources have decreased yearly utilization of land. On average in this group the annual use of tractors stood at 35.87 cgh·ha⁻¹ of cropland, and was three times higher than the average in the West Pomerania Province (cgh 12.03 · ha⁻¹ of cropland). Such a large use of tractors on farms in the Małopolska Province - notwithstanding its smaller resources of the earth,

Table 2. Characteristics of tractor park

Specification		Farms							
		Małopolska Province				West Pomerania Province			
		including area [ha]:							
		Average	0-5 ,0	5,1-15,0	15,1-30,0	Average	5,1-15,0	15,1-30,0	30,1- 50,0
[pcs · ha ⁻¹ of cropland]									
Tractros		0,21	0,33	0,24	0,14	0,04	0,013	0,10	0,02
in this:	class 6 kN	0,15	0,26	0,17	0,09	0,03	0,12	0,08	0,01
	class 9 kN	0,05	0,07	0,07	0,03	0,01	0,02	0,02	0,01
	class 14 kN	0,02	0,00	0,01	0,02	0,00	0,02	0,00	0,01
[pcs · farm ⁻¹]									
Tractros		2,40	1,25	2,57	3,25	2,20	1,75	2,17	2,60
in this:	class 6 kN	1,73	1,00	1,86	2,25	1,40	1,50	1,67	1,00
	class 9 kN	0,60	0,25	0,71	0,75	0,53	0,25	0,50	0,80
	class 14 kN	0,20		0,14	0,50	0,20	0,25		0,60
[years]									
Age		22	29	21	20	18	24	19	15
Time of use		18	23	20	14	16	20	18	10
Annual usage									
[cgh·ha ⁻¹ of cropland]		35,87	45,64	32,40	31,56	12,03	18,67	31,40	6,73
[cgh·farm ⁻¹]		408,80	175,50	347,14	750,00	619,33	280,00	693,33	802,00
[cgh·pcs· ⁻¹]		170,3	140,4	135,0	230,8	281,5	140,0	320,0	308,5

[Source: own research]

was doubtless dictated by the structure of the crop, in which the important role was played by time-consuming cultivation of vegetables (often repeated agrotechnical treatments such as spraying, fertilizing). In each of the separate groups, both in terms of location and resources of agricultural land (area group), the value of the annual usage rate was increasing with the increasing of possessed area of agricultural land. In the households of the

Małopolska Province it was in the range 175.50 - 750.00 and in the second region 280,00-802,00 cgh · farm⁻¹. In the equipment of the tested objects in most cases there were at least two tractors, so for comparative purposes Table 2 also contains data on the average annual use per one tractor. The results are varied within the grouping variable for the assumed location-voivodship. In the group 5,1-15,0 ha of area in the two voivodships the value of

Table 3. Quantitative equipment of machinery park

Specification	Farms							
	Małopolska Province				West Pomerania Province			
	including area [ha]:							
	Average	0-5,0	5,1-15,0	15,1-30,0	Average	5,1-15,0	15,1-30,0	30,1- 50,0
	[pcs · ha ⁻¹ of cropland]							
Ploughs	0,09	0,26	0,09	0,04	0,02	0,07	0,05	0,01
Soil aggregate	0,06	0,13	0,08	0,03	0,01	0,03	0,01	0,01
Manure spreader	0,05	0,20	0,04	0,02	0,01	0,05	0,04	0,00
Fertilizer distributor	0,06	0,07	0,08	0,03	0,02	0,03	0,05	0,01
Grain drill	0,09	0,26	0,09	0,04	0,01	0,03	0,05	0,01
Point drills	0,02	0,00	0,03	0,02	0,00	0,00	0,01	0,00
Automatic planters	0,06	0,07	0,08	0,03	0,01	0,07	0,01	0,00
Spraying machines	0,08	0,26	0,08	0,04	0,01	0,05	0,02	0,01
Rotary mower	0,05	0,07	0,07	0,03	0,01	0,07	0,03	0,00
Pick-up balers	0,02	0,00	0,03	0,02	0,01	0,03	0,01	0,00
Potato diggers	0,02	0,20	0,00	0,01	0,01	0,02	0,02	0,00
Potato harvesters	0,06	0,07	0,08	0,04	0,01	0,03	0,01	0,00
Beet harvesters	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00
Combine-harvesters	0,04	0,07	0,04	0,02	0,02	0,05	0,05	0,01
Delivery vans	0,07	0,07	0,09	0,04	0,00	0,02	0,01	0,00
Trailers	0,12	0,13	0,12	0,09	0,03	0,13	0,06	0,01
	[pcs · farm ⁻¹]							
Ploughs	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Soil aggregate	0,73	0,50	0,86	0,75	0,47	0,50	0,17	0,80
Manure spreader	0,53	0,75	0,43	0,50	0,60	0,75	0,83	0,20
Fertilizer distributor	0,67	0,25	0,86	0,75	0,93	0,50	1,00	1,20
Grain drill	1,00	1,00	1,00	1,00	0,67	0,25	1,00	0,60
Point drills	0,27		0,29	0,50	0,07		0,17	
Automatic planters	0,67	0,25	0,86	0,75	0,33	0,75	0,17	0,20
Spraying machines	0,93	1,00	0,86	1,00	0,67	0,75	0,33	1,00
Rotary mower	0,60	0,25	0,71	0,75	0,60	0,75	0,67	0,40
Pick-up balers	0,27		0,29	0,50	0,27	0,50	0,17	0,20
Potato diggers	0,27	0,75	0,00	0,25	0,27	0,25	0,50	
Potato harvesters	0,73	0,25	0,86	1,00	0,27	0,50	0,17	0,20
Beet harvesters					0,13		0,33	
Combine-harvesters	0,40	0,25	0,43	0,50	0,93	0,75	1,00	1,00
Delivery vans	0,80	0,25	1,00	1,00	0,20	0,25	0,17	0,20
Trailers	1,33	0,50	1,29	2,25	1,40	1,75	1,33	1,20

[Source: own research]

this ratio differed by 67.14 cgh·pcs⁻¹, in the case of the other comparable group (15,1-30,0 ha of cropland), this difference was 56,67 100 cgh · pcs⁻¹ (Table 2).

The machinery park in the surveyed holdings include cultivation machinery and tools, machines for fertilization and plant protection and harvesting machine. There was no presence of machines and tools directly used in livestock production which is clear from the orientation of production test items, which were focused on plant production. Table 3 contains details of the number of machines, for comparative purposes the results are given in the [pcs · ha⁻¹ of cropland] and [pcs · farm⁻¹].

As is clear from the data of Table 3 in each of the tested objects there was a plough in the equipment, an average farm in the Małopolska Province also owned a grain seeder, where for comparison in the second voivodship there were 0.67 pcs · farm⁻¹. Among the harvesting machinery, in case of harvesters, in the West Pomerania Province they belonged to the equipment in almost every household, while in the Małopolska Province only in every other farm. In both groups the lack of sugar beet harvesters was noted, not counting the one exception in West Pomerania Province. This is undoubtedly dictated by the adverse changes that occur in our country when it comes to decreasing the cultivation area of this plant.

One of the indicators that can be a criterion in the selection of individual machines is the installed capacity in agricultural tractors. This is the parameter which the farmers are guided by in choosing the machines and related equipment. It is important to choose tractors and machinery to make it possible to leverage the existing capacity resources.

Table 4 contains the values of individual components of the total of the installed appliances in the examined farms. In each of the separate groups, agricultural tractors have the largest share. In the objects of the Małopolska Province, the average per hectare of arable land is 9.05 kW, while in the West Pomerania Province only 1.99 kW. Let's compare the two groups with the same area, i.e. 5,10-15,00 ha of cropland and 15,1-30,00 ha of cropland and we see that in the West Pomerania Province this ratio is much lower. Hence the conclusion that in these objects tractors have less power than the objects of the second group with the similar farming conditions (like the land resources). In the households of the Małopolska Province a significant share in the total power values were also cars that were used primarily to transport crops (vegetables) on the markets. Their average power was 40.13 kW · farm⁻¹, for comparison in the group from the West Pomerania Province it was only 0.15 kW · farm⁻¹.

The possessed machinery park is the value of capital invested in the farm, because the work includes the gross replacement value ratio computed in accordance with the approved methodology as the value of new machinery. Analyzing the results, it was noted that the average index value for one household only slightly differs for groups within the investigated objects by location and this difference is only about 20 t PLN.

It is noted that the differences in the value of index appear, when we examine the ratio of the gross replacement value of the existing resources of the land. In this situation, we see that the average per hectare of land in the West Pomerania Province is only 5.46 t PLN, while

Table 4. The installed appliances in the machinery park

Specification		Farms							
		Małopolska Province				West Pomerania Province			
		including area [ha]:							
		Average	0-5,0	5,1-15,0	15,1-30,0	Average	5,1-15,0	15,1-30,0	30,1- 50,0
		[kW·ha ⁻¹ of cropland]							
Total		14,95	15,98	17,57	10,44	3,46	9,89	7,43	1,96
in this:	vans	3,52	2,48	4,52	2,36	0,15	0,64	0,29	0,06
	tractors	9,05	9,92	10,06	6,73	1,99	6,34	3,77	1,28
	self-propelled	2,16	2,93	2,75	1,25	1,24	2,73	3,22	0,57
	other	0,21	0,65	0,23	0,10	0,08	0,18	0,15	0,05
		[kW·farm ⁻¹]							
Total		170,39	61,45	188,26	248,08	178,03	148,33	164,00	233,10
in this:	vans	40,13	9,55	48,46	56,15	7,64	9,55	6,37	7,64
	tractors	103,16	38,15	107,83	160,00	102,61	95,15	83,25	151,98
	self-propelled	24,67	11,25	29,50	29,63	63,80	40,88	71,17	67,60
	other	2,43	2,50	2,47	2,30	3,98	2,75	3,22	5,88

[Source: own research]

in the Małopolska Province up till 22.97 t PLN. Noticeable differences are also between groups of the same area (5,10-15,00 ha of cropland and 15,1-30,00 ha of cropland) in both voivodships. Thus, it can be concluded that the households of the Małopolska Province are excessively invested in, and available resources of land may not be sufficient to generate revenues allowing for continuous recovery process - the modernization of the owned machinery park.

CONCLUSIONS

Currently, in the Polish agriculture there have been a number of changes, on the one hand connected with our country's accession to the European Union, and therefore with the need to compete with the agriculture of the EU countries, on the other hand changes are dictated by the opportunity to create a development that makes the EU subsidies available. From previous studies, among others by the author of this study, it has been shown that subsidizing agriculture is largely directed at the modernization of technical infrastructure. Farmers who have started using the EU funds, spend the money on technical investments by purchasing new machinery and tools. In this way, they "rejuvenate" the machinery park and thereby increase its value, and rationally access its individual elements. Responding to the questions posed at the beginning of this article it can be concluded that the objects included in the comparison groups differed as to the standard of machinery park equipment, as evidenced by the calculated values of the indicators. This diversity manifests itself primarily in the quantitative index of

equipment in relation to individual machines, which in turn was reflected in the replacement value of machinery park calculated for each of the separate groups, both in location (in the West Pomerania Province - 5.46 t PLN · ha⁻¹ of cropland, while in the Małopolska Province - 22.97 t PLN · ha⁻¹ of cropland) and resources of agricultural land (for example, a group of area 5.00 - 15.00 hectares in the West Pomerania Province - 15.36 t·ha⁻¹ of cropland, while in the Małopolska Province - 28.42 t·ha⁻¹ of cropland). Differences also occurred in the indicators characterizing the tractors, whose average number was about 2 pcs · farm⁻¹ in both voivodships, however, in relation to the calculated land resources the values differed significantly. Contrary to expectations, while it might seem that the higher value of the annual use of farm tractors should occur in the West Pomerania Province, because of a greater acreage of arable land, the situation appeared to be reversed. The households from the Małopolska Province had a higher use of farm tractors, which on average in a year worked at 35.87 cgh · ha⁻¹ of cropland, whereas at 12.03 cgh · ha⁻¹ in the West Pomerania Province. Undoubtedly, that was due to the fact that farms in the Małopolska Province had a significant percentage of laborious vegetable crops.

In conclusion we can say that according to the conducted research, the standard of equipment in the machinery park is a major problem in the field of agricultural engineering. It seems reasonable to make researches on these issues in different contexts. The results clearly indicate that the target of the efficiency of use of technical means in agriculture should be seen in the context of the growing area of agricultural land and also of the small farms increasing the production intensity.

Table 5. Gross replacement value of the machinery park

Specification		Farms							
		Małopolska Province				West Pomerania Province			
		including area [ha]:							
		Average	0-5,0	5,1-15,0	15,1-30,0	Average	5,1-15,0	15,1-30,0	30,1- 50,0
		[t PLN · ha ⁻¹ of cropland]							
Total		22,97	27,86	28,42	14,37	5,46	15,36	12,92	2,70
in this:	vans	4,23	3,15	5,47	2,78	0,19	0,81	0,37	0,80
	tractors	7,72	10,71	9,28	4,82	1,44	4,14	3,36	0,76
	self-propelled	3,97	4,88	5,21	2,24	2,45	4,80	6,07	1,23
	other	7,05	9,13	8,47	4,52	1,38	5,61	3,11	0,63
		[t PLN·farm ⁻¹]							
Total		261,74	107,14	304,55	341,42	281,12	230,45	285,24	322,24
in this:	vans	48,20	12,13	58,57	66,13	9,70	12,13	8,08	9,70
	tractors	87,94	41,16	99,46	114,55	74,39	62,14	74,26	90,79
	self-propelled	45,25	18,75	55,81	53,25	125,92	72,00	134,12	146,62
	other	80,36	35,10	90,71	107,50	71,11	84,18	68,79	75,13

[Source: own research]

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REGIONALNE ZRÓŻNICOWANIE WYPOSAŻENIA PARKU MASZYNOWEGO W GOSPODARSTWACH ROLNYCH

Streszczenie. Celem pracy było dokonanie analizy poziomu wyposażenia parku maszynowego gospodarstw zróżnicowanych pod względem ich lokalizacji. W trakcie badań przeprowadzonych w formie wywiadu kierowanego, dobrano obiekty z woj. Małopolskiego i Zachodniopomorskiego. Uzyskane wyniki pozwalają wnioskować, iż w przypadku badanych gospodarstw istnieją różnice w poziomie wyposażenia parku maszynowego. Przykładem jest m.in. wartość mocy zainstalowanej w ciągnikach, gdzie w obiektach z woj. Małopolskiego jest to średnio 9,05 kW·ha⁻¹UR, zaś w woj. Zachodniopomorskim tylko 1,99 kW·ha⁻¹UR.

Słowa kluczowe: maszyny rolnicze, ciągniki, park maszynowy, gospodarstwo rolne.