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THE LEVEL OF TECHNICAL EQUIPMENT OF ORGANIC FARMS AND PRODUCTION RESULTS

Summary

The objective of the paper was to determine the impact of organic farms equipment with technical production means on the economic outcomes. The research covered 50 organic farms located in the southern Poland. Equipment of farms with technical production means, basic production categories and the index of technical equipment efficiency (W_{UT}) as well as the technical investment index (W_{IT}) were determined. Low equipment of farms with machines and transport means in comparison to the conventional farms was reported. It was calculated that each PLN 100 spent on maintenance and exploitation of the machinery park allowed achieving an agricultural income at the level of PLN 13.
***Key words**: farm, ecology, equipment, production, technical investment index*

POZIOM TECHNICZNEGO UZBROJENIA GOSPODARSTW EKOLOGICZNYCH A WYNIKI PRODUKCYJNE

Streszczenie

Celem pracy było określenie wpływu wyposażenia gospodarstw ekologicznych w techniczne środki produkcji na wyniki ekonomiczne. Zakresem pracy objęto 50 gospodarstw ekologicznych położonych w Polsce Południowej. Określono wyposażenie gospodarstw w techniczne środki produkcji, podstawowe kategorie produkcji oraz wskaźnik efektywności uzbrojenia technicznego (W_{UT}) oraz wskaźnik inwestycyjności technicznej (W_{IT}). Stwierdzono niskie wyposażenie gospodarstw w maszyny i środki transportowe w porównaniu do gospodarstw konwencjonalnych. Obliczono, że każde 100 PLN wydatkowane na utrzymanie i eksplantację parku maszynowego pozwoliło osiągnąć dochód rolniczy na poziomie 13 PLN.
***Słowa kluczowe**: gospodarstwo, ekologia, uzbrojenie, produkcja, wskaźnik inwestycyjności technicznej*

1. Introduction

In the recent years the change of farms from traditional to organic has been observed in Poland. The statistical data collected in the base of the Inspectorate of the Commercial Quality of Agri-food Products (Polish IJHAR'S) show that in 2014 the total area of agricultural land under organic crops decreased by approximately 2 % and the number of organic farms by 7% in comparison to 2013 [13, 15]. This trend may result from a deteriorating economic situation of these farms and the necessity to concentrate the production. Many research show that organic production is generally less efficient with regard to production factors [11], less profitable than the traditional one [10] and thus more work consuming [11, 12].

The agricultural production process requires high financial inputs not only for the purchase of production means but also maintenance of the machinery park. Searching for rational proportions in the inputs for production concerns mainly agricultural machines and tools because it prominently influences the achieved economic results. One should remember that the costs of manufacture of organic products are considerably higher than in traditional farms and the yield is lower at the average by 20-40% [1, 4, 7]. Therefore, it is significant that the organic farms have a relevant machinery park which preconditions high efficiency of production processes, the quality of produced goods and achieving a relevant level of incomes [16, 19].

2. Objective, scope and methodology

The objective of the paper was to determine the impact of organic farms equipment with technical production means on the economic outcomes. The study covered 50 organic farms located in the southern Poland. The collected data came from 7 municipalities from farms which have been carrying out an organic system for at least 3 years.

Based on the detailed studies present equipment of farms with technical production means was determined. Moreover, fundamental production categories were indicated. The final stage was to calculate the index of technical equipment effectiveness (W_{UT}) in the investigated objects as a ratio of agricultural income and replacement value of the machinery park and the index of technical investment (W_{IT}) as a ratio of agricultural income and the value of the machinery park.

In order to carry out a comparative analysis, farms were divided into 4 groups which differed with the size of agricultural land, i.e. group I - up to 5 ha, group II - 5.01 to 10.00 ha, group II - 10.01 to 20.00 ha and group IV above 20 ha. Table 1 presents the structure of the investigated agricultural farms. The average area of agricultural land in the investigated population was 12.24 ha at the area of entire farm achieving the value of 14.48 ha. The difference between the above values consists mainly of forests - on the average of 1.49 ha and the land under development and roads - at the average 0.71. In all area groups in the structure of farms, the agricultural land constitutes the highest participation which in 87.6% constituted the property of farm owners.

3. Research results

Organic farming requires constant scientific research, which will support its development. Traditional knowledge provided by advisers at the present stage of organic farming development requires scientific support. Taking appropriate decisions related to the production technology, selection of machines, storing, marketing or distribution of organic goods should be related to the previous information on the detailed data within this scope [6]. Availability of modern and efficient farming equipment is one of factors which determine carrying out effective agricultural production. Level of this equipment and modernity of the used mechanization means is also one of characteristic features of economic development of a particular farm. Development of agricultural technique and demand for agriculture mechanization means depends on the one hand on the needs and on the other hand on the possibilities of their realization [8, 17].

Table 2 presents the equipment of farms with farm tractors, transport and loading means in the system of farm groups and types of these means.

Farm tractors of the investigated farms constituted a basic energy mean. They served as the main source of mechanical tractive and driving force as well as transport and loading means. Many authors [3, 5, 6, 7, 9] indicate such universal use of tractors, not only in organic farms.

The investigated farms had a high saturation in equipment with farm tractors. On the average per a farm, there were 1.72 items of tractors in the investigated farms. When comapring this saturation in the area groups system, one may note a logical increase in the number of these technical means (0.85-2.8 item·farm^{-1}) per a statistical farm along with the increase of this area. It should be mentioned, however, that these tractors were old, worn and cooperate mainly with the equally old equipment (average age 20 years) which translates into the use of old and work consuming technologies in the investigated farms. As a result there is no innovativeness.

Equipment of organic farms in delivery cars is very low. Since, on the average per a farm there was 0.16 item of this vehicle. As a result every seventh farm could supply its product systematically on the market. Freshness of organic products is one of their assets. This, however, cannot be ensured without an appropriate transport mean so that the produce are supplied to the shops shortly after harvesting. Facilities with the area of 10.01 to 20.00 ha are the best equipped which results from the fact that this group is characterised by the highest participation of vegetables in the sowing structure.

Equipment of faciliies with the remaining tractor means in the form of trailers, tractor wagons, wagon, regardless of the farm size is varied. Often, one trailer or a horse wagon adapted to a tractor is a multi-functional machine and serves for transport of produce in the varied form. Therefore, only 1.34 item was per a farm but in the highest ones - this index was 1.80 item.

Table 1 Total area of farms on the average in groups (ha)
Tab. 1. Powierzchnia ogólna gospodarstw średnio w grupach (ha)

Farm group	Parameter	Area (ha)				
		Total area	Area of AL	Forests	Buildings, roads	Water
up to 5 ha	average	3.77	3.32	0.09	0.29	-
	standard deviation	1.07	0.94	0.17	0.18	-
5.01 – 10.00 ha	average	8.91	6.92	1.41	0.49	0.09
	standard deviation	3.91	1.52	2.83	0.28	0.36
10.01 – 20.00 ha	average	16.25	14.48	0.74	1.03	-
	standard deviation	3.66	3.28	1.43	1.32	-
area 20.00 ha	average	36.08	30.63	4.18	1.28	-
	standard deviation	12.76	10.65	3.26	1.82	-
Total	average	14.48	12.24	1.49	0.71	0.03
	standard deviation	13.22	11.17	2.66	1.06	0.21

Source: own work / *Źródło:* opracowanie własne

Table 2. Equipment of farm with farm tractors, transport and loading means in the system of farm groups and types of these means
Tab. 2. Wyposażenie gospodarstw w ciągniki rolnicze, środki transportowe i ładunkowe w układzie grup gospodarstw oraz rodzajów tych środków

Farm group	Parameter	Number of tractors		Number of transport and loading means					
				Delivery trucks		Remaining transport means		Loading and unloading devices and machines	
		[item·farm^{-1}]	[item·ha^{-1}]	[item·farm^{-1}]	[item·ha^{-1}]	[item·farm^{-1}]	[item·ha^{-1}]	[item·farm^{-1}]	[item·ha^{-1}]
up to 5 ha	average	0.85	0.24	-	-	1.15	0.33	0.08	0.02
	standard deviation	0.55	0.16	-	-	1.34	0.40	0.28	0.07
5.01–10.00 ha	average	1.59	0.23	0.18	0.03	1.29	0.18	-	-
	standard deviation	0.87	0.10	0.39	0.06	1.10	0.15	-	-
10.01–20.00 ha	average	2.00	0.14	0.40	0.03	1.20	0.09	0.00	0.000
	standard deviation	0.70	0.05	0.52	0.04	0.63	0.06	0.04	0.00
area 20.00 ha	average	2.80	0.09	0.10	0.005	1.80	0.06	0.10	0.005
	standard deviation	1.32	0.04	0.32	0.01	1.03	0.03	0.32	0.01
Total	average	1.72	0.19	0.16	0.02	1.34	0.18	0.04	0.005
	standard deviation	1.09	0.12	0.37	0.04	1.08	0.24	0.20	0.01

Source: own work / *Źródło:* opracowanie własne

Equipment of farms with machines and devices for loading and unloading was also very low - 0.04 item·farm^{-1}. Therefore, except for a few self-unloading trailers, loading and unloading was practically based on the manual work in the investigated farms.

According to Szeptycki [12], technological changes trends may be carried out through the access to modern technical means equipped more and more with automatics and IT systems. As a result of the decrease in the number of commodity farms which specialize in specific production trends, current conditions of tractors and agricultural machines are too excessive for the production demands of farms and the majority of fixed assets used in the Polish agriculture do not meet the demands of the production technologies and modernized farms. Table 3 presents the average age, replacement value and the costs of exploitation of machines in particular farm groups.

The replacement value of machines calculated acc. to the method applied in the Institute of Agricultural Engineering of the University of Agriculture in Krakow [2, 3] per a statistical farm considerably varies and is within 143,986 PLN·farm^{-1} in the smallest farms to 541,333 PLN·farm^{-1} in the biggest farms. On the average for the entire population of farms this value was 442,311 PLN·farm^{-1}. Thus, one may state that the replacement value of the machinery park is relatively low in comparison to the demands for securing modern and innovative technologies regardless the area group. The third group of farms is the most favourable in this respect.

However, per one hectare of AL farms are loaded with the machinery park value in the amount of: the first group - PLN 43,369, second group - PLN 61,558, third group - PLN 52,407 and the fourth group - PLN 17,673. On the average one hectare of AL is burdened with PLN 36,136. Based on the calculations each hectare of a farm up to 5 ha of AL is burdened with the machinery park value of approx. PLN 50 thousand. The biggest farms have this index lower by approx. 2-7 times. These relations result, inter alia, from the fact that a farm regardless its size, on account of technology must be equipped with some machines and tractors and it must be burdened with the costs of use and maintenance, thus with costs of exploitation (amortization, insurance, fuel and costs of repair). In total, exploitation costs of machines per a statistical farm were 31,919 PLN·farm annually, which generates the value of PLN 2,608 per 1 hectare.

Production results in the form of the production categories were presented in table 4. Commodity production as one of the most important categories for direct agricultural producers in the investigated organic farms was annually on the average PLN 58,157 which at the direct costs at the level of PLN 12,059 gave a direct margin in the amount of PLN 46,097.

However, it should be emphasised that the commodity production in particular area groups on account of the varied sowing structure and the scale of manufactured goods varied and was within 23,481 PLN·year^{-1} in farms up to 5.00 ha of AL to 108,479 PLN·year^{-1} in facilities with the acreage of 10.01-20.00 ha AL.

Table 3. Average age, replacement value and the costs of machines exploitation in farm groups [PLN·year^{-1}]
Tab. 3. Średni wiek, wartość odtworzeniowa i koszty eksploatacji maszyn w grupach gospodarstw [PLN·rok^{-1}]

Farm group	Parameter	Average age [years]	Replacement value [PLN·farm^{-1}]	Costs of of exploitation of machines [PLN·year^{-1}]
up to 5 ha	average	19	143,986	11,998
	standard deviation	9	123,101	4,988
5.01 – 10.00 ha	average	22	425,987	27,333
	standard deviation	6	313,220	13,559
10.01 – 20.00 ha	average	22	758,862	45,694
	standard deviation	6	721,289	33,497
above 20.00 ha	average	17	541,333	51,837
	standard deviation	5	230,858	17,939
Total	average	20	442,311	31,919
	standard deviation	7	432,721	23,740

Source: own work / *Źródło:* opracowanie własne

Table 4. Size of commodity production and agricultural income in farms according to area groups
Tab. 4. Wysokość produkcji towarowej i dochodu rolniczego w gospodarstwach wg grup obszarowych

Farm group	Parameter	Commodity production	Direct costs*	Direct margin	Clear production	Agricultural income	Agricultural income
		[PLN·year^{-1}]					[PLN·ha^{-1}]
up to 5 ha	average	23,481	3,980	19,501	21,849	18,433	4,658
	standard deviation	25,736	3,251	26,396	29,167	28,810	6,706
5.01 – 10.00 ha	average	27,679	9,007	18,672	22,447	18,175	2,797
	standard deviation	18,041	5,522	16,499	21,460	20,862	3,115
10.01 – 20.00 ha	average	108,479	12,765	95,713	101,428	95,621	7,207
	standard deviation	130,688	9,282	130,693	133,778	130,482	9,613
above 20.00 ha	average	104,307	28,633	75,674	147,308	142,046	4,485
	standard deviation	61,585	16,100	57,013	80,679	82,359	2,302
Total	average	58,157	12,059	46,097	62,142	57,577	4,555
	standard deviation	77,293	11,981	73,742	87,919	86,648	6,046

* - direct costs with energy carriers for production (diesel oil, leaded petrol, electric energy)

Source: own work / *Źródło:* opracowanie własne

The newly manufactured value in the production processes, namely clean production in the investigated organic farms was also varied - from 21,849 PLN·year^{-1} in facilities with the area of 5.01-10.00 ha AL to as much as 147,308 PLN·year^{-1} in the biggest facilities above 20 ha of AL. The consequence of the calculated clean production was the agricultural income. Its scope was (for the same abovementioned area groups) from 4,658 to 4,484 PLN:ha^{-1} AL. For the entire population it was 4555 PLN·ha^{-1} AL on the average.

The index of technical equipment efficiency is a measure that determines the relation between the agricultural income and the machinery park value and the technical investment index as a ratio of the replacement value of the park to agricultural income. Table 5 presents the above mentioned indexes in particular farm groups.

Table 5. Indexes of effectiveness of technical equipment and technical investment
Tab. 5. Wskaźniki efektywności uzbrojenia technicznego i inwestycyjności technicznej

Indexes	Farm groups [ha]				
	up to 5.00	5.01-10.00	10.01-20.00	above 20.00	Total
W_{UT}	0.11	0.05	0.14	0.25	0.13
W_{IT}	9.31	22.01	7.27	3.94	7.93

Source: own work / *Źródło:* opracowanie własne

The calculations which were carried out prove that the highest index of technical equipment efficiency was reported in the biggest farms - the area of 20 ha and the lowest in the farm group with the area of 5.01-10.0 ha. In case of the biggest farm is means that each PLN 100 spent on maintenance and use of the machinery park gave a chance to generate agricultural income at the level of PLN 25 while in the group of objects from 5.01-10.0 ha it is a 5 times lower value. When analysing the technical investment index value it was stated that the objects with the area of 5.01-10.0 ha have the highest index and the biggest farms - area above 20 ha - the lowest. An average index for the investigated facilities from the Małopolska region was 7.93. It means that in order to generate agricultural income one should invest in the machinery park the amount of PLN 7.93. The obtained indexes prove low effectiveness of using the owned machinery park.

4. Conclusions

1. The investigated farms are equipped with old machines (average age is 20 years) and its quantity compared to the research [5] is two times and sometimes three times lower than in traditional farms.
2. Equipment of organic farms with tractors and transport means is at a low level. It is confirmed by the research [5].
3. Each hectare of farms up to 5.00 ha of AL is loaded with the replacement value of the machinery park of PLN 50 thousand. The biggest farms (above 20 ha) have this ratio by approx.. 2.7 times lower.
4. On the average in the investigated objects each PLN 100 spent on maintenance and use of the machinery park gave a chance to generate agricultural income at the level of PLN 13.
5. In order to generate agricultural income in the amount of PLN 1 one should invest in the machinery park the amount of PLN 7.93.

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