

ASSESSMENT OF TECHNICAL MEANS OF PRODUCTION RESOURCES ON ORGANIC FARMS*

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Abstract. On an example of 100 organic farms the paper presents their technical means of production resources. The following were identified among the technical means of production: tractors, cultivation aggregates, machinery for organic fertilization, plant tending, sowing, planting and harvesting, and for livestock production. Tractor resources were on the level of 1.53 pcs-farm⁻¹, whereas in the group of largest farms (more than 20 ha AL) – 2.40 pcs-farm⁻¹. Studied farms were best equipped with cultivation machinery and tools but poorly in cereal and root crops harvesters.

Key words: organic farm, resources, technical means of production

Introduction

Organic farming is a modern system of agricultural production, which makes use of the experience of past generations and the latest research achievements. It is an intensive agriculture where agro-chemical means are replaced by natural, organic means and human labour is used to a larger extent. This production is more difficult since it requires a deeper knowledge and better comprehension of the mechanisms acting in nature but it is also more labour consuming replacing a lack of artificial fertilizers and chemicals used for plant protection [Stachowicz, Pomykała 2008].

Methods used in crop production rely on the application of:

- proper crop rotation considering structure forming plants, which also increase organic matter content in soil,
- soil surface vegetal cover for the longest possible period during the year,
- green fertilizers, composts, natural and organic fertilizers,
- natural plant protection and microorganisms, and live organisms allowed for use in organic farming,
- ecological seed and propagation material,
- appropriate varieties designed for organic farming which have natural resistance to diseases [Kibler 2009].

A dynamic development of organic farming in Poland after accession into the European Union in 2004, created a need to conduct investigations and analyses concerning this sector

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of agriculture. It became important to identify the current production and economic situation of organic agricultural farms and their competitiveness on the outer markets, the more so as the number of agricultural producers interested in running production by means of ecological methods is growing systematically [Kowalska 2010]. In order to improve organic farming competitiveness towards other agri-production systems it is necessary to increase the effectiveness of production outlays. One of the ways is decreasing production costs, where the basic component are mechanization costs which in some cases reach even 40% of the total costs of production [Sawa 1998; Lorencowicz, Kocira 2000; Kocira 2005; Tabor, Cupiał 2005]. Therefore, the proper selection and use of technical means of production may provide a basis for improvement of agricultural production process effectiveness.

Aim, scope and methods

Effectiveness of farming is to a considerable extent determined by adequate resources of technical means of production on farm, therefore the paper aimed to assess organic farm possession of basic machinery for crop and livestock production. The work covers initial research conducted on 100 certified organic farms, situated in southern Poland. The farms are located in the following districts: Charsznica, Gdów, Gołcza, Iwanowice, Jerzmanowice, Kocmyrzów-Luborzycza, Krempna, Krynica Zdrój, Liszki, Michałowice, Miechów, Niepołomice, Nowe Brzesko, Olkusz, Przegonia, Radziszów, Skąpa, Słaboszów, Słomniki, Uście Gorlickie, Wieliczka, Wielka Wieś, Wolbrom, Zabierzów, Zabierzów Bocheński and Zielonki.

The investigations were conducted in the framework of development grant No. 12-0165-10 entitled: "Innovative effect of technique and technology and IT support of management on production effectiveness on organic farms". The information was gathered by means of directed interviews with farm owners. Among the technical means of production identified were: tractors, cultivation aggregates, machinery for organic fertilization, plant tending, sowing, planting and harvesting, and for livestock production.

Investigated organic farms were divided into four area groups:

- I group – (below 5.00 ha) – 31 farms
- II group – (5.01 – 10.00 ha) – 32 farms
- III group – (10.01 – 20 ha) – 23 farms
- IV group – (more than 20 ha) – 14 farms.

The assumed division into area groups corresponds with the area groups specified in the report on the state of organic sector in Poland in 2009-2010 [Raport IJHARS 2009-2010].

Results

The arable land area (AL) and the number of tractors on the studied organic farms were presented in Table 1. Average AL area was 11.85 ha fluctuating from 2.88 ha in the smallest area group to 37.85 ha in the largest area group, i.e. farms possessing more than 20 ha AL. Tractors, which are the main source of mechanical traction force, were crucially important for each farm. On average, there was 1.53 pcs of farm tractor per farm and 0.22 pcs per field area unit (1ha).

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Table 1. Arable land area and tractors (mean values)

Area group	Arable land area (AL)	Tractors								Total	
		Ursus		Zetor		Massey Ferguson		Other*			
	[ha]	[pcs·farm ⁻¹]	[pcs·ha ⁻¹]	[pcs·farm ⁻¹]	[pcs·ha ⁻¹]	[pcs·farm ⁻¹]	[pcs·ha ⁻¹]	[pcs·farm ⁻¹]	[pcs·ha ⁻¹]	[pcs·farm ⁻¹]	[pcs·ha ⁻¹]
I	2.88	0.77	0.27	-	-	0.03	0.01	0.13	0.04	0.94	0.35
II	7.10	0.91	0.13	0.16	0.02	0.19	0.03	0.22	0.03	1.47	0.22
III	14.55	1.18	0.08	0.14	0.01	0.05	0.00	0.50	0.03	1.86	0.13
IV	36.86	1.13	0.03	0.53	0.01	0.53	0.01	0.20	0.01	2.40	0.07
Total	11.90	0.96	0.08	0.16	0.01	0.16	0.01	0.25	0.02	1.53	0.22

* - other tractors (T25A, MTZ82, Casse, Fortschritt, Farmtrac, Class Axos)

Source: author's own studies

The cases when farm owners did not possess any tractors and made use totally of mechanization services, were noted only among the investigated objects in group I. However, in the other area groups some farms owned 2 or 3 tractors (particularly in group IV). It should be emphasized that tractors of lower traction force, i.e. 6 kN prevailed in the smallest farm groups (I and II). The average number of tractors per farm was growing with their area and fluctuated from 0.94 pcs on the smallest objects to 2.40 pcs on the largest farms. On the other hand, the number of tractors per hectare was decreasing with increasing arable land acreage and ranged from 0.35 pcs·ha⁻¹AL on the smallest farms to 0.07 pcs·ha⁻¹AL on farms with 20ha AL. Ursus tractors were most common in each area group.

The index of power installed in tractors for the studied organic farms was on average 6.97 kW·ha AL⁻¹ (Table 2). Because tractors of Ursus C330 and C 360 type were the most frequently registered, for them the installed power was definitely the highest (in comparison with other identified tractor groups) and was on average 4.94 kW·ha AL⁻¹. On the other hand, among Zetor tractors the most frequently encountered types were: Z5211, Z7211 and Z5245, among Massey Ferguson MF255, MF3060 and MF 3065 tractors. The other types mentioned in the tractor group as "other" were single sporadic cases.

On the basis of conducted studies an apparent trend of a decline in installed power (kW·ha⁻¹) was observed with growing farm area. The highest index of installed power was registered for the smallest area farms – 10.91 kW·ha AL⁻¹ and the lowest – 2.79 kW·ha AL⁻¹ in the largest objects. These results confirm previous research conducted by Kocira and Parafiniuk [2006] and Szeptycki and Wójcicki [2003]. However, for a single farm, the installed power was definitely growing with the acreage and was on the level of 29.61 kW on the smallest farms to 102.76 kW on the largest area farms.

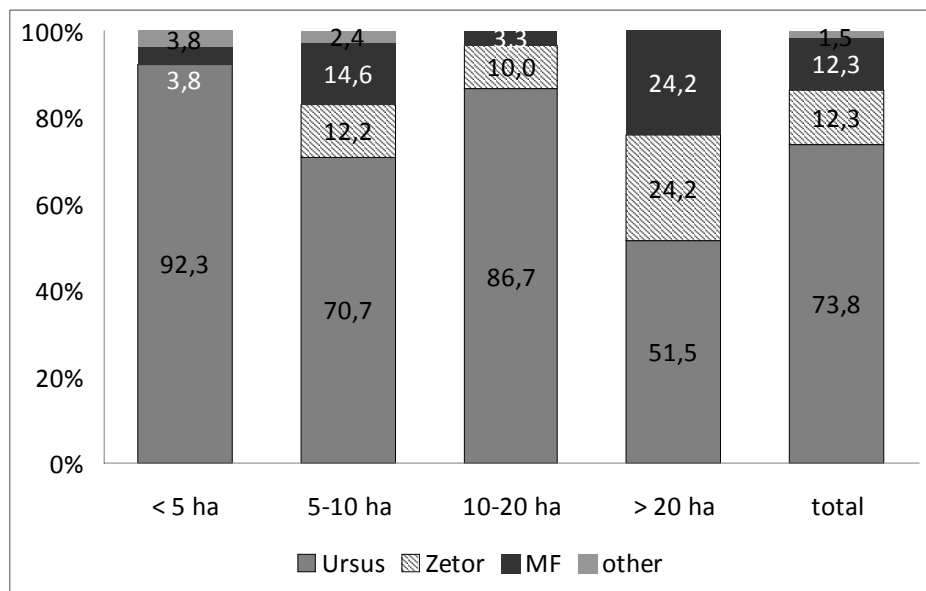


Fig. 1. Structure of tractor types in the studied group of farms

Table 2. Power installed in farm tractors (average values)

Area group	Arable land area (AL)	Farm tractors								Total	
		Ursus		Zetor		Massey Ferguson		Other			
	[ha]	[kW·farm ⁻¹]	[kW·ha AL ⁻¹]	[kW·farm ⁻¹]	[kW·ha AL ⁻¹]	[kW·farm ⁻¹]	[kW·ha AL ⁻¹]	[kW·farm ⁻¹]	[kW·ha AL ⁻¹]	[kW·farm ⁻¹]	[kW·ha AL ⁻¹]
I	2.88	24.86	9.57	-	-	1.15	0.32	3.59	1.01	29.61	10.91
II	7.10	24.48	3.77	3.73	0.68	7.30	0.97	9.26	1.26	44.78	6.67
III	14.55	38.78	2.75	6.16	0.33	2.64	0.13	20.38	1.51	67.95	4.73
IV	36.86	36.85	1.07	21.87	0.50	31.85	0.82	12.20	0.40	102.76	2.79
Total	11.89	29.6	4.94	5.83	0.36	8.05	0.56	10.39	1.11	53.87	6.97

Source: author's own studies

Table 3 shows the studied farms' machinery resources used for tillage, organic fertilization, sowing and planting, but also for mechanical plant protection and harvesting cereals and potatoes.

Considering the identified area groups, the resources may be assessed as greatly diversified and for some machinery groups very poor. An example is provided by machinery for cereal harvesting, only 0.14 pcs·farm⁻¹, potato harvesters – 0.04 pcs·farm⁻¹ and passive

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cultivation aggregates – 0.17 pcs·farm⁻¹. Also the number of loaders and septic tanker trucks may be regarded as very small.

On the other hand, as adequate may be regarded the number of possessed basic cultivation tools, of which 3.18 pcs per farm was noted. These comprise mostly ploughs (on average 1.15 pcs·farm⁻¹) and harrows (on average 0.93 pcs·farm⁻¹). This machinery and tool group constituted jointly 47% of all technical means of production. Machinery for fertilization and tending, which made up 25% of all machines, stood out in the quantitative structure of machinery resources. On the other hand, the share of machinery for plant seeding and planting, and harvesting constituted respectively: 16 and 11%. Generally it may be stated that every second organic farm possessed cereal sower (0.56 pcs·farm⁻¹), potato planter (0.48 pcs·farm⁻¹) and tractor-mounted potato spinner (0.57 pcs·farm⁻¹).

Table 3. Machinery resources (transport, tillage, organic fertilization, sowing, planting and harvesting) on farms

No.	Specification	Area group									
		I		II		III		IV		Total	
		[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]
1	Ploughs	0.90	20.6	1.22	16.8	1.27	15.8	1.33	16.6	1.15	17.3
2	Spike tooth harrows	0.90	20.6	0.88	12.1	1.05	13.1	0.93	11.6	0.93	14.0
3	Discs harrows	0.06	1.4	0.19	2.6	0.18	2.2	0.53	6.6	0.20	3.0
4	Cultivators	0.55	12.6	0.56	7.7	0.41	5.1	0.20	2.5	0.47	7.1
5	Rotary cultivators	0.26	5.9	0.22	3.0	0.36	4.5	0.20	2.5	0.26	3.9
6	Passive cultivation aggregates	0.03	0.7	0.19	2.6	0.36	4.5	0.13	1.6	0.17	2.6
7	Manure loaders	0.03	0.7	0.41	5.6	0.68	8.5	0.60	7.5	0.38	5.7
8	Manure spreaders	0.23	5.3	0.78	10.7	0.82	10.2	0.93	11.6	0.64	9.6
9	Septic tanker trucks	0.06	1.4	0.13	1.8	0.23	2.9	0.47	5.9	0.18	2.7
10	Weeders/furrowers	0.39	8.9	0.53	7.3	0.45	5.6	0.60	7.5	0.48	7.2
11	Cereal sowers	0.32	7.3	0.66	9.1	0.68	8.5	0.67	8.4	0.56	8.4
12	Potato planters	0.16	3.7	0.59	8.1	0.73	9.1	0.53	6.6	0.48	7.2
13	Cereal combine harvesters	0.03	0.7	0.19	2.6	0.18	2.2	0.20	2.5	0.14	2.1
14	Potato spinners	0.42	9.6	0.66	9.1	0.59	7.3	0.67	8.4	0.57	8.6
15	Potato combine harvesters	0.03	0.7	0.06	0.8	0.05	0.6	-	-	0.04	0.6

Source: author's own studies

The technical means of production used on farms for hay and green forage harvesting and livestock production were presented in Table 4. In both of these machinery groups machines for hay and green forage harvesting plainly prevailed quantitatively constituting 69%. An assessment of quantity of these machines possessed by the studied farms revealed

a considerable difference in the number of rotary mowers and wheel rake swath turners between the groups I and II (below 5 ha and 5.01-10,00 ha) and II and IV (10.01-20.00 ha and over 20.00 ha). In the first case the numbers of mowers were 0.74 and 0.88 pcs·farm⁻¹ and in the second, respectively (1.14 and 1.20 pcs·farm⁻¹). On the other hand, in the first case the number of wheel rake swath turners on farms was 0.39 and 0.88 pcs·farm⁻¹ and respectively, between 1.23 and 1.20 pcs·farm⁻¹ in the second.

Table 4. Resources of machinery for hay harvesting and livestock production

No.	Specification	Farm area group									
		I		II		III		IV		Total	
		[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]	[pcs·farm ⁻¹]	[%]
1	Rotary mowers	0.74	41.8	0.88	27.7	1.14	22.3	1.20	21.7	0.94	26.8
2	Wheel rake swath turners	0.39	22.0	0.88	27.7	1.23	24.0	1.20	21.7	0.85	24.2
3	Pick-up balers	0.10	5.6	0.38	11.9	0.55	10.7	0.67	12.1	0.37	10.5
4	Swath pickups	-	-	0.16	5.0	0.55	10.7	0.47	8.5	0.24	6.8
5	Pneumatic stackers	0.03	1.7	0.03	0.9	0.05	1.0	-	-	0.03	0.9
6	Milking machines	0.13	7.3	0.28	8.8	0.55	10.7	0.67	12.1	0.35	10.0
7	Milk coolers	0.19	10.7	0.16	5.0	0.64	12.5	0.53	9.6	0.33	9.4
8	Machines for feed preparation	0.19	10.7	0.38	11.9	0.41	8.0	0.47	8.5	0.34	9.7
9	Manure gatherers	-	-	0.03	0.9	-	-	0.33	6.0	0.06	1.7

Considering the equipment for livestock production, the studied farms were quite well equipped with milking machines, milk coolers and machinery for fodder preparation, whereas a small share of manure gatherers indicates that excrement removal is only at the stage of modernisation. While comparing the identified farm area groups one should notice that better resources of machinery and devices for livestock production were on bigger area farms, i.e. in the III and IV group (similar as for machinery for hay and green fodder harvesting).

Conclusions

1. The number of tractors possessed by the studied organic farms was on average 1.53 pcs·farm⁻¹ and 0.22 pcs·ha⁻¹AL. In the group of largest area farms (over 20 ha AL) there were 2.40 pcs, whereas on the smallest objects (below 5 ha AL) – 0.94 pcs·farm⁻¹. Owners of these farm most frequently used mechanization services.
2. Power installed in farm tractors revealed a declining tendency with increasing arable lands area. The index for the studied farms was on average 6.97 kW·ha AL⁻¹ and tractors of Ursus C330 and C360 prevailed among the used tractors.

3. It may be generally stated that the studied farms were well equipped only with farm tractors, machinery and tools for tillage (ploughs, spike tooth harrows). On farms with acreage over 5 ha also adequate number of manure spreaders, cereal sowers and potato planters was noticed. The poorest resources of cereal and potato combine harvesters were registered.
4. Considering machinery for green forage harvesting, suitable resources of rotary mowers and wheel rake swath turners, pick-up balers and swath pickups should be emphasized in the III and IV group. These groups of farms were also better equipped with milking machines and milk coolers in comparison with groups I and II, which suggests a bigger scale of livestock, mainly milk production on larger area farms.

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OCENA WYPOSAŻENIA GOSPODARSTW EKOLOGICZNYCH W TECHNICZNE ŚRODKI PRODUKCJI

Streszczenie. W pracy przedstawiono na przykładzie 100 gospodarstw ekologicznych wyposażenie w techniczne środki produkcji. Wśród technicznych środków produkcji wyszczególniono ciągniki rolnicze, maszyny uprawowe, maszyny do nawożenia organicznego, pielęgnacji, siewu, sadzenia, zbioru, a także do produkcji zwierzęcej. Wyposażenie w ciągniki rolnicze kształtowało się na poziomie 1,53 szt·gosp.⁻¹, a w grupie gospodarstw największych (ponad 20 ha UR) - 2,40 szt·gosp.⁻¹. Badane gospodarstwa były najlepiej wyposażone w maszyny i narzędzia uprawowe, natomiast słabo w maszyny do zbioru zbóż i roślin okopowych..

Słowa kluczowe: gospodarstwo ekologiczne, wyposażenie, techniczne środki produkcji

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