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Biodiversity of the crop structure on farms participating in the Polish FADN in terms of the requirements of the Common Agricultural Policy

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Abstract. The crops structure (or cropping pattern) of a farm is a production and economic feature of a farm. In addition, it is an element shaping the biodiversity of rural areas.

The paper presents research on the diversity and uniformity of the structure of crops on farms of various production directions and economic size, participating in the Polish FADN network. We use three biodiversity indicators: the number of plant species cultivated on the farm, the Shannon-Wiener index (H') and the Pielou equality index (J').

The research showed the differences of the biodiversity indicator of the crop structure and its uniformity. The greatest diversity (Shannon-Wiener index) (H' = 1.59) and uniformity (J' = 0.71) of crops were found on farms with permanent crops, where the share of arable lands did not exceed 25%. Farms with field crops with a high share of industrial plants and potatoes had lower values of the indicators (H' = 1.42 and J' = 0.63, respectively), Different results were recorded on farms with granivorous animals, with the lowest diversity (H' = 0.93) and uniformity (J' = 0.42). Those farms had also the highest share of cereals in crop structure (75.5%).

In the analysis of farms in terms of economic size, the highest value of the crop structure diversity index (H' = 1.51) was found on big farms (100≤thous. €<500), with the highest share of industrial plants and vegetables in field cultivation. The lowest diversity, decreasing with the economic size of farms, was characteristic for very small farms (2≤thous. €<8) with the highest (75.3%) share of cereals.

Taking into account the requirements of crop diversification applicable under greening policy, the limit values of the indicators of diversity and uniformity of the crop structure were determined for farms with more than 10 ha of arable land. The comparison of the crop structure indexes obtained in the research with their limit values for farms with different production directions showed that for all compared groups of farms the diversity of the crop structure exceeded the limit value. On the other hand, the uniformity of the sown structure was at the level of the limit value only on farms with field crops, and in other cases it did not exceed the limit value. In the case of all groups of farms, depending on the economic size, the diversity of the crop structure exceeded the limit value, and in the case of its uniformity, this applied to farms with an economic size of more than 50 thousand €.

Keywords: crop structure, crop diversity and uniformity, natural environment, Polish FADN.

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INTRODUCTION

Rural areas, defined as areas outside the administrative boundaries of cities, including rural municipalities and the rural part of urban-rural municipalities, covered 29.1 million hectares in Poland in 2018 and accounted for 93% of the domestic area (Rural areas..., 2018). On the other hand, the number of farms operating in the country in 2019 was 1.4 million. Their area occupied 16.3 million hectares (56.0% of the rural regions), of which the agricultural land (UAA)was 14.7 million hectares (89.4%).

According to the Statistics Poland (Statistical Yearbook..., 2020), the cropping area in Poland in 2019 was 10.9 million hectares, and the share of sown basic grains and industrial crops (including rapeseed), potatoes and vegetables amounted to a total of 72.0%, of which basic grains alone accounted for 56.9%. These figures testify to the low diversity of the sowing structure, where cereals play a dominant role, the share of which directly and indirectly affects the level of farm income (Wasilewska, 2008). According to Feledyn-Szewczyk et al. (2016), the degree of management intensity in ongoing agricultural activities can affect the species biodiversity of organisms found in agricultural fields. An example cited by the authors is conventional agriculture with simplified rotations and intensive production, which contributes to a decrease in the biodiversity of organisms.

The concept of agricultural biodiversity in a broader sense is presented by Tyburski (2013). He points out that it can be viewed at two levels: related to the diversity of

species and varieties of crops and species and breeds of livestock; and as the biodiversity of plants and wildlife accompanying agricultural production. Thus, the cropping pattern, adapted to the natural conditions and the production direction of the farm, in addition to organizational and economic functions, should also be taken into account as an element affecting the preservation of biodiversity on the farm, as well as a factor affecting the maintenance of biodiversity of the rural landscape. According to Feledyn-Szewczyk et al. (2016), the crop structure found on a farm is closely related to crop rotation, considered one of the approaches to increasing biodiversity on arable land (AL).

The issue of biodiversity is widely reflected in strategic documents at both the EU and national levels. One of the elements of the „European Green Deal" (EGD), which serves as a comprehensive, long-term strategy for the Union's economic development, presented by the EC in 2019, is protecting and restoring ecosystems and biodiversity. Meanwhile, the overall targets for biodiversity protection and commitments to address the leading causes of biodiversity loss are included in the „EU Biodiversity Strategy 2030". The announcement of intensified action concerning preserving biodiversity also found a place in the „From Field to Table" strategy. Its expression was the cooperation of the European Commission with member states so that national strategic plans, including the „Strategic Plan for the Common Agricultural Policy 2023-2027" prepared by Poland, fulfill the ambitious assumptions of the EGD and related strategies in this regard.

With the Common Agricultural Policy (CAP) implementation, various measures were pursued to enhance rural biodiversity. Among other actions, one was to link direct payments to farmers to comply with requirements and standards to protect the rural environment by increasing its biodiversity. The initial measure was maintaining agricultural land in good condition by meeting cross-compliance needs. Since 2015 the implementation of „greening" requirements manifested, among other things, in crop diversification on farms with more than 10 hectares of arable land.

The Farm Accountancy Data Network (FADN), operating in the country since 2004, is a database collected according to uniform principles by which farms form a statistically representative sample of commercial farms operating within the European Union. Determination of the farm's standard output value (SO), considering the agricultural activities carried out on it, expressed in euros, allows it to be classified in the appropriate economic size class. On the other hand, the share of the SO value from individual agricultural activities in the total SO value of a farm makes it possible to determine its agricultural type. At the same time, farms participating in the Polish FADN network can be representative when it comes to assessing the biodiversity of the sowing structure of crops grown on arable land and, thus, its impact on rural biodiversity.

Determining the biodiversity of crop structure on farms participating in the Polish FADN network according to the direction of production and economic size, as well as its compliance with CAP requirements, was the research goal.

MATERIALS AND METHODS

The research was based on data from 2015–2017 from 12102 to 12104 farms, depending on the year, participating in the Polish FADN network (Bocian et al. 2017; 2018; 2019). For the relevant studies, the grouping of farms used for FADN purposes was adopted according to 8 general agricultural types (production directions). They were distinguished based on the share of the standard output (SO) value from individual rural activities in the creation of the total SO value of the farm and economic size. To eliminate the variability of the results from year to year, the analysis of the cropping structure, including individual crop groups and species, was based on an average of three years.

The indicators commonly used in agroecological studies were employed to assess the sowing structure's environmental impact (Falińska, 2004; Feledyn-Szewczyk, 2016; Jaskulska et al., 2012; Sienkiewicz, 2010). The diversity of the cropping pattern was assessed using the Shannon-Wiener index (*H'*), which calculates the cropped area of the i-th group or species to the sum of the cropped area of all groups and species in the structure of cropland (p_i); (the cropped area of individual cropping groups and species is not presented in the paper). The above proportion was then multiplied by the natural logarithm of this proportion ($ln\ p_i$), and the resulting products for each group and species were summed and multiplied by (*-1*) according to the following formula:

$$H' = -\sum_{i=1}^{S}(p_i)(\ln p_i)$$

The values of the sowing structure diversity index in the farm with different production directions gained in the study were decided to refer to the threshold indicators calculated for farms with more than 10 hectares of arable land, which, among other things, through crop diversification, meet the greening requirements. It is noteworthy that this is one of the new CAP instruments conditioning the receipt of part of area payments in 2014–2020 (Materiał informacyjny..., 2019). The group of farms with an area of 10–30 hectares AL requires growing at least 2 different crops, with the main crop not occupying more than 75% of arable land. Calculated for such assumptions, the limiting value of the sowing diversity index equals 0.56. Meanwhile, farms with an area of more than 30 hectares AL are obliged to cultivate at least 3 different crops, where the primary crop must not cover more than 75% of arable land, and 2 crops together must not cover more than 95% of arable land, the limiting index of sowing structure diversity is 0.69.

The study also analyzed the uniformity of the contribution of the cultivated area of each cropping group and species to the sowing structure of the farms, applying Pielou's equality index (*J'*). It expresses the ratio of actual (*H'*) to maximum (H'_{max}) diversity.

$$J' = \frac{H'}{H'_{max}}$$

where: $H'_{max} = ln\ S$
S – number of total cultivated crop species

The value of the *J'* index ranges from 0 to 1, where 1 denotes the total uniformity of the cultivation area of each group and species.

The cut-off value of the uniformity index calculated for farms meeting the conditions for greening (for farms with 10 to 30 hectares of AL) was 0.81, and the limit value of the index mentioned above estimated for farms with more than 30 hectares of AL amounted to $J' = 0.63$.

Furthermore, for the organizational characteristics of the farms, average data from 3 years (2015–2017) were applied concerning land use, livestock stocking rate, the soil valuation index of UAA and the main cropping systems for groups of farms by agricultural type and economic size.

RESULTS AND DISCUSSION

Farms with different lines of production. A study of farms from the Polish FADN network with different production directions revealed that farms with field crops (50.11 hectares) stood out as having the largest average area of agricultural acreage (UAA); (Table 1), and this was almost five times larger than the average UAA for an average farm in Poland, which was 10.3 hectares in 2018 (Land use ..., 2019). By contrast, farms with horticultural crops (6.84 hectares) and permanent crops (13.26 hectares) featured the smallest average UAA area. Farms with herbivorous animals, however, were distinguished by the largest share of permanent grassland (44.2%), and the percentage of arable land (AL) in them was 55.7%. On farms with field crops, as well as those with granivores, the share of permanent grassland was marginal (3.6%), and the share of AL exceeded 95%. Farms distinguished the lowest claim of AL (23.6%) with permanent crops, in which permanent plantations occupied 73.6%.

An assessment of soil quality based on the bonitation index (Harasim, 2006) showed that farms with dairy cows and herbivorous animals had the weakest UAA soils (Table 1) due to the high proportion of permanent grassland. Farms with granivorous animals also featured poor soils. At the same time, the UAA bonitation index on horticulture farms took a value of 0.8, slightly below the lower range limit for medium soils. Farms with field crops, permanent crops and multidirectional were located on the finest – medium soils (with a 0.82–0.99 soil quality index).

Farms with granivorous animals, i.e. those raising pigs and poultry, were characterized by the highest livestock density, amounting to as many as 365 large units (LU) per 100 ha UAA (Table 1). The above rate far exceeded the environmentally acceptable livestock density recommended by the Code of Good Agricultural Practice (2.5 LU/ha UAA – 250 LU/100 ha UAA); (Duer et al., 2002). In contrast, farms with dairy cows and herbivorous animals, with a high proportion of permanent grassland, had stocking densities below those recommended by the code, 127 and 94 LU/100 ha UAA, respectively. Farms with horticultural crops and field crops had the minimum animal density, indicating production for self-supply, and virtually no animal production were farms engaged in permanent crops (0.8 LU/100 ha UAA).

The diversity index of the crop structure calculated for individual groups of farms with different production directions (Table 3) assumed the lowest value (0.93) in farms with granivorous animal husbandry. The farms were distinguished by the highest share of cereals in the sowing structure (75.5%) (Table 2), resulting from the implementation of crop rotation consistent with the direction of production, and a relatively high share of oilseed crops (8.2%). Majewski (2010), using the Herfindahl-Hirshman Concentration Index (HHI), which for Poland was 0.66, ranked Poland among the countries with the highest concentration index

Table 1. Land use structure and their quality in FADN farms with various specialization (2015-2017).

Farms by production direction	Agricultural area (UAA) [ha]	Share [%]			Livestock density [LU/100 ha UAA]	Soil valuation index of UAA
		arable land (AL)	permanent crops	permanent grassland		
Field crops	50.11	95.9	0.5	3.6	5.2	0.99
Horticulture	6.84	86.8	4.2	9.0	8.0	0.80
Permanent crops	13.26	23.6	73.6	2.8	0.8	0.92
Dairy cows	32.01	65.4	0.0	34.6	127.4	0.64
Herbivorous animals	29.04	55.7	0	44.2	94.2	0.58
Granivorous animals	33.36	96.3	0.1	3.6	365.1	0.76
Multidirectional	29.25	87.6	0.5	12.0	88.5	0.82

Source: author's calculations based on FADN data

of sowing structure (typified by crop groups), mainly due to the high share of cereals. At the same time, he found that Polish agriculture is characterized by one of the lowest HHI indices (0.28) for grain crop structure. This is related to the diversity of soil conditions and the common practice of growing cereals (including Poland-specific cereal mixtures) to produce their own concentrated feed on farms with livestock production. Here the author pointed out that farmers usually grow 2–3 different species of cereals, appropriately selected for the soil conditions. Likewise, a study of family farms in the FADN database conducted in Lithuania (Dabkienė, 2016) found that the lowest crop diversity characterized farms with granivorous animals. Meanwhile, Gerrard et al. (2012), in a study conducted in the UK for conventional farms, proved the lowest crop diversity on farms with grassland animals (especially those located in LFA – less-favoured areas), which were dominated by permanent grassland.

On farms with granivores, as on farms with horticultural crops, the average number of cultivated crop species was relatively low (9.0 and 8.7, respectively).

The highest cropping system diversity was observed in farms with permanent crops (1.59), where permanent plantations dominated. The sowing structure on AL, accounting for only 23.6% of farmland, was distinguished by the highest share of field vegetables and, as in farms with dairy cows, the lowest share of cereals, not exceeding 50% (Table 2). In the above group of farms, the quantity of crop species was relatively high (9.3).

Relatively high crop structure diversity was observed in farms with field crops (1.42) (Table 3), with one of the highest counts of crop species (9.7) and distinguished by the highest share of industrial crops and potatoes in the cropping pattern, which was facilitated by the highest land quality in this group of farms. The contribution of cereals here was 54.5% – slightly exceeding half of the sown area (Table 2). Likewise was the case in a study of the diversity of sowing structure by voivodeship (Matyka, 2017). The highest index of diversity and uniformity was found in regions where multidirectional production dominated. In a study by Dabkienė (2016), family farms in Lithuania (from the FADN database) specializing in field cultivation of various crops, including mixed farms with different crops, were also characterized by high crop diversity. Gerrard et al. (2012) reached similar conclusions in research on conventional farms in the UK. They found the highest crop diversity on farms with field crops, followed by cereal crops and multidirectional. Whereas, in a study of the variety of sowing structure on farms with different production directions, using data from the CSO (Madej, 2019), it was concluded that farms with crop production with the smallest average number of crop species had the lowest index of diversity and uniformity of crop structure.

For dairy cattle and herbivorous animal farms, with the highest share of fodder crops on arable land (47.9 and 41.8%, respectively) (Table 2), complementing the natural forage area (permanent grassland) and a relatively high number of cultivated crop species (9.7 and 9.3 species), the diversity of sowing structure was similar at 0.98 and 1.01, respectively (Table 3). The value of the uniformity index was also at an equivalent level (0.43 and 0.45).

In the group of multidirectional farms, the share of cereals in the sowing structure did not exceed 2/3. The sowing of industrial crops and potatoes and the cultivation of fodder crops on AL (9.1%) also played a significant role in such farms (Table 2). Despite the high average number of crop species (9.7), these farms did not stand out in terms of both the diversity index (1.23) and uniformity (0.54) of their disposition of crops (Table 3). Madej's (2019) study of the diversity of crop structure on farms with different production directions showed that multidirectional farms with the highest average number of crop species had the highest index of diversity and uniformity of crop structure. Also, in Dabkienė's (2016) study, mixed family farms (field crops and herbivorous animals) from the Lithuanian FADN database exhibited the highest crop diversity index.

Among the farm groups analyzed, only farms with field crops and those rearing granivorous animals had more than 30 hectares of AL (Table 1). The value of the crop diversity index calculated for these farm groups was higher than the threshold value (0.69), suggesting that the biodiversity of the crop structure was higher than that required under

Table 2. The cropping system in FADN farms with various specialization (2015-2017).

Farms by production direction	Share [%]						
	cereals	oilseeds	potatoe	sugar beets	fodder	field-grown vegetables	other
Field crops	54.5	19.8	2.5	3.6	1.6	1.9	16.1
Horticulture	46.6	3.0	0.8	0.1	4.5	3.2	41.8
Permanent crops	46.7	4.2	1.3	0.5	6.5	3.7	37.1
Dairy cows	45.9	1.4	0.7	0.9	47.9	0.0	3.2
Herbivorous animals	51.1	1.5	1.0	0.8	41.8	0.0	3.8
Granivorous animals	75.5	8.2	0.5	1.4	1.9	0.1	12.4
Multidirectional	66.0	9.4	2.0	3.1	9.1	0.4	10.0

Source: author's calculations

Table 3. The cropping system diversity index (H') and uniformity index (J') in FADN farms with various specialization (2015–2017).

Farms by production direction	The cropping system diversity index (H')	The cropping system uniformity index (J')	Average number of species per farm
Field crops	1.42	0.63	9.7
Horticulture	1.38	0.64	8.7
Permanent crops	1.59	0.71	9.3
Dairy cows	0.98	0.43	9.7
Herbivorous animals	1.01	0.45	9.3
Granivorous animals	0.93	0.42	9.0
Multidirectional	1.23	0.54	9.7

Source: author's calculations

greening, particularly on farms with field crops. According to a study by Korsak-Adamowicz et al. (2012), implementing a crop rotation system with three different crops is an important activity in an integrated system. The farmers surveyed by the authors implemented such crop rotation in the vast majority (90%). In addition, they declared the cultivation of legumes and other plants that improve soil fertility, while fulfilling the species diversity obligation. Yet in the remaining FADN farms (with the exception of farms with horticultural and permanent crops), the AL area ranged from 10 to 30 hectares. The value of the crop diversity index calculated for these farms also exceeded its limit value (0.56), especially in multidirectional farms.

As for the index of the sowing structure uniformity, its smallest value was characterized by groups of farms with dairy cows and herbivores and granivores (0.42–0.45); (Table 3). The relatively low values of the index were due to the wide range of shares of particular crops in the sowing structure, reaching from 0.0 to 51.1% or from 0.1 to 75.5% (Table 2). The value of the index for such groups was lower than the calculated threshold value, which was 0.81 for farms with dairy cows and herbivores (up to 30 hectares of AL), and 0.63 for farms with granivores with more than 30 hectares of AL. Even in the group of farms with permanent crops, with the highest value of the uniformity index (0.71), the such index was lower than the threshold value. Only farms with field crops had a uniformity index (0.63) comparable to the limit value of this index for farms with more than 30 hectares of AL.

Farms by economic size class. Six groups of farms were distinguished in terms of the above indicator. With its rise, there was an increase in the area of UAA, as well as an improvement in the share of arable land, from 79.8% in very small farms (2≤thous. €<8) to 95.0% in very big farms (thous.€≥500) (Table 4). The opposite trend was observed for permanent grasslands, the share of which was highest on very small farms (18.2%). At the same time, the largest share of permanent crops was distinguished by small farms (8≤thous. €<25); (3.1%). On the other hand, regarding the quality of soils, very small and very big farms had the worst quality soils (with a soil valuation index of 0.74 and 0.76, respectively). Meanwhile, in the other farm groups, an upward trend in the soil valuation index was noted as the farm's economic size increased. The finest soils, with a validation index of 0.89, were available to large farms (100≤thous. €<500). In contrast, the highest livestock density of 453 LU/100 ha UAA, exceeding the environmentally safe density recommended by the code of good agricultural practice (250 LU/100 ha UAA) (Duer et al., 2002), occurred on very big farms. In other farm groups, its size did not pose environmental risks.

Analysis of the cropping system revealed that the highest share of cereals in the cropping structure prevailed on very small farms (75.3%) and decreased as the economic size of the farm increased to 49.2% on very big farms (Table 5). Kęsik (2008) points out that the share of cereals in the cropping pattern, which exceeds 70% in Poland, forces

Table 4. Land use structure and their quality in FADN farms with various economic size (2015–2017).

Farms by economic size [thous. €]	Agricultural area (UAA) [ha]	Share [%]			Livestock density [LU/100 ha UAA]	Soil valuation index of UAA
		arable land (AL)	permanent crops	permanent grassland		
Very small 2≤ thous. €<8	8.92	79.8	2.0	18.2	25.1	0.74
Small 8≤ thous. €<25	16.87	80.0	3.1	16.9	42.5	0.80
Medium small 25≤ thous. €<50	30.88	82.0	1.8	16.2	64.2	0.83
Medium big 50≤ thous. €<100	51.82	85.2	0.8	14.0	79.5	0.85
Big 100≤ thous. €<500	101.03	91.5	0.4	8.1	96.8	0.89
Very big thous. €≥500	174.55	95.0	0	5.0	453.0	0.76

Source: author's calculations based on FADN data

Table 5. The cropping system in FADN farms with various economic size (2015–2017).

Farms by economic size [thous. €]	Share [%]						
	cereals [%]	oilseeds [%]	potatoe [%]	sugar beets [%]	fodder [%]	field-grown vegetables	other [%]
Very small 2≤ thous. €<8	75.3	4.7	2.2	0.3	8.7	0.3	8.5
Small 8≤ thous. €<25	67.0	8.1	2.2	1.5	9.5	0.7	11.0
Medium small 25≤ thous. €<50	59.9	10.7	2.1	2.7	12.7	1.0	10.9
Medium big 50≤ thous. €<100	55.0	13.7	1.6	3.0	14.6	1.0	11.1
Duże/big 100≤ thous. €<500	51.0	17.1	1.7	3.4	9.9	1.4	15.5
Very big thous. €≥500	49.2	15.9	6.4	0.3	4.4	0.0	23.8

Source: author's calculations

Table 6. The cropping system diversity index (H') and uniformity index (J') in FADN farms with various economic size (2015–2017).

Farms by economic size [thous. €]	Cropping system diversity index (H')	Cropping system uniformity index (J')	Average number of species per farm
Very small 2≤ thous. €<8	0.97	0.43	9.7
Small 8≤ thous. €<25	1.22	0.54	9.7
Medium small 25≤ thous. €<50	1.37	0.60	9.7
Medium big 50≤ thous. €<100	1.43	0.63	9.7
Big 100≤ thous. €<500	1.51	0.68	9.3
Very big thous. €≥500	1.42	0.75	6.7

Source: author's calculations

the use of crop rotations and cereal monocultures, having an adverse environmental impact. And he considers the decrease in the share of structuring crops (perennial legumes) and legumes grown for seed, potatoes and other root crops to be worrisome. A relatively high percentage of cereals (accounting for more than two-thirds of the sown area) also stood out for farms with an economical size in the 8≤thousand €<25 range. In turn, farms with a size of 50≤thous. €<100 were featured by the highest share of fodder crops on AL (14.6%) and, similarly to big farms (100≤thous. €<500), a high share of sugar beets. Big farms also exhibited the highest share of oilseed crops (17.1%) and vegetables in the field (1.4%). On the other hand, in addition to a relatively high share of oil crops, very big farms were also characterized by the highest share of potato and other crops, including grain corn, in the sowing structure.

The study showed an increase in the crop structure diversity index with an increase in the economic size of the farm, with the highest value in large farms (100≤thous. €<500) (H' = 1.51) (Table 6). At the same time, it was more than twice as high as the indicator's threshold value (0.69), resulting from CAP greening requirements. These were farms with a relatively low share of cereals in sowings and a high share of oilseeds, sugar beets, or vegetables in field crops. An increase in crop diversity, with an increase in the economic size of family farms from the Lithuanian FADN network, was also found in Dabkienė's (2016) study. Very small farms distinguished the lowest value of the indicator of crop structure biodiversity with the highest share of cereals in sowings. However, the value of this indicator, to its limit one, calculated for farms with an AL area of fewer than 30 hectares (0.56), was more than 1.7 times higher. It proves favorably the biodiversity of sowings in this group of farms. On farms with economic size classes in the range of 2≤thous. €<100, the average number of cultivated species was the highest (9.7).

The value of the index of crop structure uniformity was the lowest in very small farms (2≤thous. €<8) (0.43); (Table 6), with the highest share of cereals in the crop pattern. On the other hand, as the economic size of farms increased, and thus the allocation of cereals in the sowing structure decreased, the value of the index increased, reaching the highest value of J' = 0.75 in very big farms. The calculated value of the index only in the group of farms with an economic size of more than €50 thousand was equal to or greater than the limit value, which for these farms (having more than 30 hectares of AL) was J' = 0.63, and in the groups of farms 8≤thous. €<50 the calculated value of the index did not exceed the limit value (J' = 0.81). This testified to a less favorable sowing uniformity than that resulting from the recommendations of greening under the CAP.

CONCLUSIONS

1. Research conducted on farms participating in the Polish FADN network with different production directions revealed the differences in the biodiversity indicator of the crop structure and its uniformity. The greatest diversity (Shannon-Wiener index) (H' = 1.59) and uniformity (J' = 0.71) of crops were found on farms with permanent crops, where the share of arable lands did not exceed 25%. Farms with field crops with a high share of industrial plants and potatoes had lower values of the indicators (H' = 1.42 and J' = 0.63). Different results were recorded on farms with granivorous animals, with the lowest diversity (H' = 0.93) and uniformity (J' = 0.42). Those farms had also the highest share of cereals in crop structure (75.5%).

2. In the analysis of farms in terms of economic size, the highest value of the crop structure diversity index (H' = 1.51) was found on big farms (100≤thous. €<500), with the highest share of industrial plants and vegetables in field cultivation. The lowest diversity, decreasing with the economic size of farms, was characteristic for very small farms (2≤thous. €<8) with the highest (75.3%) share of cereals.

3. Taking into account the requirements of crop diversification applicable under greening policy, the limit values of the indicators of diversity and uniformity of the crop structure were determined for farms with more than 10 ha of arable land. The comparison of the crop structure indexes obtained in the research with their limit values for farms with different production directions showed that for all compared groups of farms the diversity of the crop structure exceeded the limit value. On the other hand, the uniformity of the sown structure was at the level of the limit value only on farms with field crops, and in other cases it did not exceed the limit value. In the case of all groups of farms, depending on the economic size, the diversity of the crop structure exceeded the limit value, and in the case of its uniformity, this applied to farms with an economic size of more than 50 thousand €.

4. The results of the obtained research can serve as a reference for determining greening requirements for farms in Poland in the future CAP.

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