

## TYPES OF EU COUNTRIES AGRARIAN STRUCTURE, BASED ON FUZZY STRUCTURE CLASSIFICATION

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### ABSTRACT

The paper identifies the types of agrarian structure of the European Union member states, based on the fuzzy classification method. The research is based on the Eurostat data regarding the number of agricultural holdings by areal groups and the utilised agricultural area they represent in different countries. Poland and Romania belong to the EU countries with the smallest average size of utilised agricultural area (UAA) per farm, and, as a consequence, semi-subsistence holdings have a dominant position (Popescu and Condei, 2015; Timofti et al., 2015) in both countries. The following areal groups were taken into account in the analysis below: up to 2 ha of UAA, 2-5 ha, 5-10 ha, 10-20 ha, 20-50 ha, 50 ha and more. The use of fuzzy classification allowed identifying groups of countries with similar distribution of the number of holdings in different areal groups, as well as the area they represent. As a result, four types of agrarian structure of the EU countries were identified.

**Key words:** agrarian structure, EU countries, fuzzy classification.

### INTRODUCTION

Agriculture in the European Union is highly diversified. This is true especially when it comes to the agrarian structure. Studies on the diversification of the EU countries agrarian structure have been conducted by different authors (Babiak, 2010; Falkowski and Kostrowicki, 2001; Poczta, 2013; Stanko and Mikula, 2016). One of the aspects of these studies is the typology of the phenomenon, as described in, among others, the work by Falkowski and Kostrowicki (2001).

In the present paper, the authors attempt to identify types of the EU countries agrarian structure using the fuzzy classification method. This is one of many methods of statistical analysis of structures. Their main objective is the linear ranking and grouping of objects (e.g. countries), being elements of a multidimensional space of characteristics. Grouping can be conducted based on many different methods (Grabinski, 1992; Pocięcha et al., 1988). The result is the classification of objects, in which objects belonging to the same group are highly similar in terms of the

analysed characteristics, while objects belonging to different groups are not similar. The use of classification methods allows for an objective evaluation of the objects' similarity in terms of the analysed characteristics. In the paper, the fuzzy classification method is used because, as pointed out in previous studies, it proves useful in temporal-spatial studies of the agrarian structure (Bozek, 2011; Bozek, 2013).

Based on the previous research, it has been concluded that the fuzzy classification method allows distinguishing groups of EU countries featuring similar agrarian structure (Bozek, 2016). In the research, the following areal groups have been adopted: up to 5 ha of agricultural land, 5-20 ha, 20-50 ha, 50 ha and more. However, in half of the EU countries, the analysed structure is very fragmented – farms of up to 20 ha constitute over 80% of all farms. But when taking into account only four areal groups, the information is missing on the diversification of distribution of smaller farms. As a result, in the research presented in this paper (determining the types of the EU countries agrarian structure), smaller areal

groups have also been taken into account: up to 2 ha, 2-5 ha, 5-10 ha<sup>1</sup>.

The calculations are based on data from the online database resources of the European Statistical Office, Eurostat, presenting results from the last farm structure study conducted in 2013 across the EU<sup>2</sup>. The paper presents the results of agrarian structure analysis in terms of the share of farms from the identified areal groups in the total number of farms in a given country, and the percentage of UAA they represent. The following areal groups have been taken into account: up to 2 ha of UAA, 2-5 ha, 5-10 ha, 10-20 ha, 20-50 ha, 50 ha and more (Variant A). Based on fuzzy classification, the authors identified groups of countries similar in terms of the share of farms of different areal groups in the total number of farms in a given country. The results obtained were, then, compared with former analyses adopting four areal groups: up to 5 ha, 5-20 ha, 20-50 ha, 50 ha and more (Variant B).

In the same way, the analysis of the EU countries agrarian structure was conducted in terms of the percentage of UAA utilized by farms of the selected areal groups. Based on the analyses conducted, the authors identified types of agrarian structure of the European Union member states.

## MATERIAL AND METHODS

The grouping of countries according to their agrarian structure was conducted using the fuzzy classification method. It allows classifying a set of multidimensional objects  $P_1, P_2, \dots, P_n$  (in this case, countries) described by the values of  $r$  variables:  $X_1, X_2, \dots, X_r$  (in the paper, in the first classification,  $X_l$  represents the share of the number of farms from the  $l$ -th areal group in

the total number of farms in a given country, and in the second classification – the percentage of UAA utilised by farms of the  $l$ -th areal group in a given country. The point of fuzzy classification is to determine the degree of membership (similarity) of each  $P_i$  object to the  $S_j$  class, referred to as the membership function  $f_{S_j}(P_i)$ . The function takes values from the (0,1) interval, provided that the following condition is fulfilled:

$$\sum_{j=1}^K f_{S_j}(P_i) = 1 \quad (i = 1, \dots, n)$$

Higher  $f_{S_j}(P_i)$  value stands for greater similarity of the  $P_i$  object to the  $S_j$  class. The membership function also allows evaluating mutual similarity of objects: the objects whose degrees of membership in the same class are high are very similar, whereas objects whose degrees of membership in different classes are high are not similar.

There are a couple of methods of creating fuzzy classifications, which are presented in the work by Jajuga (1984). In the paper, the iterative method based on the concept of fuzzy gravity centre was implemented (Jajuga, 1984; Bozek, 2013). In subsequent iterations, the values of degrees of membership of objects in particular classes are modified. The procedure is repeated until the values stop changing in a considerable degree.

The fuzzy classification obtained in such a way was, then, transformed into classical classification, assuming that the  $P_i$  object belongs to the  $S_j$  class (topological group), when

$$f_{S_j}(P_i) = \max_l f_{S_l}(P_i).$$

## RESEARCH RESULTS

The diversification of the EU countries agrarian structure is presented in Table 1. The largest diversification is observed in the areal groups of holdings under 2 ha and over 50 ha. The smallest farms, of up to 2 ha, in 2013, accounted for 1.7% in Ireland to 75.9% in Bulgaria and Hungary (the variation coefficient is  $V=0.93$ ). The numbers are

<sup>1</sup>The adoption of different areal groups usually to different classification results, as demonstrated in Bozek et al., 2009; Bogocz et al., 2010.

<sup>2</sup>The study on the structure of agricultural holdings was conducted in 2013 in the entire EU, and its principal objective was to obtain reliable data necessary for the evaluation and development of Common Agricultural Policy tools. The results were published in December 2015.

significantly different from the average share of this areal group in EU countries, being 28.2%. The largest farms represented from 0.6% in Romania to 40.4% France ( $V=0.97$ , average 14.9%). Considerable differences can also be observed in the 20-50 ha areal group: from 0.5% in Romania to 39.3% in Ireland ( $V=0.79$ , average 13.7%). Farms of 2-5 ha

represented from 2.3% in Denmark to 34.3% in Slovenia, with the EU average of 16.8% and  $V=0.63$ . Relatively, the smallest differences can be observed in the shares of farms of 5-10 and 10-20 ha, but they are still important and amount to, respectively: from 3.2% do 23.9% and from 1.4% to 24.5%.

Table 1. Number of agricultural holdings (in %) in the EU countries by UAA areal groups in 2013

Country	Total (in thousands ha)	UAA areal groups in ha					
		<2	2-5	5-10	10-20	20-50	>50
		in %					
UE (28)	10,841	45.0	21.3	11.8	8.2	7.0	6.7
Austria	140.4	11.0	19.7	17.4	21.6	22.4	8.0
Belgium	37.8	5.3	9.3	13.2	18.0	31.2	23.0
Bulgaria	254.4	75.9	10.9	4.3	2.7	2.6	3.6
Cyprus	35.4	74.9	15.0	5.1	2.5	1.7	0.8
Czech Republic	26.3	11.4	7.2	18.6	17.5	18.3	27.0
Denmark	38.8	4.4	2.3	19.8	17.8	21.4	34.3
Estonia	19.2	11.5	21.4	20.8	17.2	13.5	15.6
Finland	54.4	2.2	3.9	11.2	20.2	34.7	27.8
France	472.2	12.7	11.9	8.7	9.5	16.7	40.4
Greece	709.5	51.4	25.3	12.2	6.4	3.7	1.0
Spain	965	28.4	24.1	14.6	11.5	10.9	10.5
The Netherlands	67.5	12.7	14.7	13.9	15.0	26.5	17.2
Ireland	139.6	1.7	5.3	11.2	24.5	39.3	18.0
Lithuania	171.8	14.2	39.1	22.4	11.7	7.0	5.7
Latvia	81.8	22.9	19.8	19.7	19.3	11.5	6.8
Germany	285	5.2	3.4	15.6	20.7	25.1	29.9
Poland	1,429	23.3	31.1	21.6	14.6	7.2	2.2
Portugal	264.4	46.4	25.9	11.8	7.0	4.9	4.0
Romania	3,629.7	73.2	19.0	5.3	1.4	0.5	0.6
Slovakia	23.6	31.4	27.5	12.3	9.3	6.4	13.1
Slovenia	72.4	25.6	34.3	23.9	11.3	4.3	0.7
Sweden	67.1	2.1	9.4	23.5	20.3	20.7	24.0
Hungary	491.3	75.9	8.7	5.2	4.1	3.2	2.9
UK	185.2	4.1	4.4	14.7	15.4	22.0	39.4
Italy	1,010.3	27.6	31.1	17.1	11.4	8.4	4.5
Croatia	157.4	38.8	30.6	15.7	8.0	4.4	2.5
Luxembourg	2.1	9.6	4.8	9.5	9.5	14.3	52.4
Malta	9.4	85.1	11.7	3.2	0.0	0.0	0.0
UE-28 average		28.2	16.8	14.0	12.4	13.7	14.9
s(x)		26.18	10.55	5.97	6.68	10.78	14.37
V(x)		0.93	0.63	0.43	0.54	0.79	0.97

Source: original calculations based on [www.europa.eu/eurostat](http://www.europa.eu/eurostat).

Using the method presented above, the fuzzy classification of countries was conducted in terms of similarity of the presented structure (with the exception of two countries: Malta and Luxembourg, due to

a small number of agricultural holdings, significantly different from that in other countries).

The calculations were performed using original software which determines the

centers of gravity of groups for a given set of multidimensional objects, and calculates the value of membership of particular objects in these groups. The initial values of the degrees of membership to fuzzy classes were set randomly, which had no influence on the final classification. Calculations were ended when the maximum (by classes and by components) of the module of difference in degrees of membership in two subsequent iterations was under 0.000001.

The calculations performed led to the identification of the following groups of countries (in brackets, the degrees of membership to the topological groups are indicated):

Group I: Bulgaria (0.989), Cyprus (0.995), Romania (0.952), Hungary (0.972);

Group II: Greece (0.759), Portugal (0.919), Slovakia (0.501), Croatia (0.925);

Group III: Austria (0.502), Estonia (0.595), Spain (0.658), Lithuania (0.735), Latvia (0.787), Poland (0.876), Slovenia (0.676), Italy (0.743);

Group IV: Belgium (0.921), Czech Republic (0.866), Denmark (0.911), Finland (0.898), France (0.663), The Netherlands (0.644), Ireland (0.755), Germany (0.977), Sweden (0.855), UK (0.872);

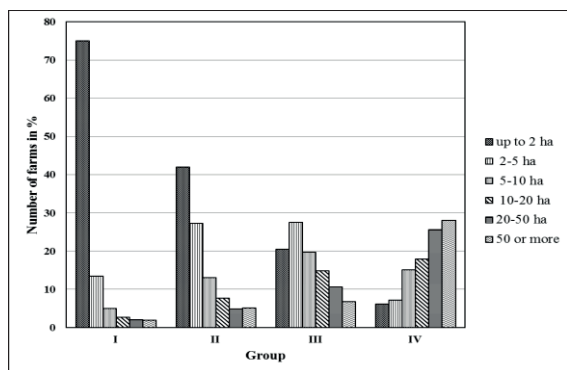
The countries with the highest degrees of membership are the “representatives” of their group, that is, countries most typical for the given group.

For each group of countries, the authors calculated the average shares of farms of different areal groups, standard deviation, and variation coefficient. The groups’ characteristics are presented in Table 2 and Figure 1.

Table 2. Characteristics of topological groups with similar distribution of the number of farms in EU countries in different areal groups (Variant A), in 2013

Group	Characteristics	UAA areal groups, in ha					
		<2	2-5	5-10	10-20	20-50	>50
		in %					
I: Bulgaria, Cyprus, Romania, Hungary	Average	<b>75.0</b>	<b>13.4</b>	<b>5.0</b>	<b>2.7</b>	<b>2.0</b>	<b>2.0</b>
	s(x)	113	3.97	0.41	0.97	1.02	1.30
	V(x)	0.02	0.30	0.08	0.36	0.51	0.66
II: Greece, Portugal, Slovakia, Croatia	average	<b>42.0</b>	<b>27.3</b>	<b>13.0</b>	<b>7.7</b>	<b>4.8</b>	<b>5.2</b>
	s(x)	7.62	2.07	1.56	1.11	0.98	4.73
	V(x)	0.18	0.08	0.12	0.14	0.20	0.92
III: Austria, Estonia, Spain, Lithuania, Latvia, Poland, Slovenia, Italy	Average	<b>20.5</b>	<b>27.6</b>	<b>19.7</b>	<b>14.8</b>	<b>10.6</b>	<b>6.8</b>
	s(x)	6.75	6.84	2.91	3.82	5.21	4.45
	V(x)	0.33	0.25	0.15	0.26	0.49	0.66
IV: Belgium, Czech Republic, Denmark, Finland, France, The Netherlands, Ireland, Germany, Sweden, UK	Average	<b>6.2</b>	<b>7.2</b>	<b>15.1</b>	<b>17.9</b>	<b>25.6</b>	<b>28.1</b>
	s(x)	4.18	3.84	4.28	3.85	7.01	7.65
	V(x)	0.68	0.54	0.28	0.22	0.27	0.27

Source: original calculations.



Source: original work.

Figure 1. Agrarian structure of topological groups of the EU countries (number of farms)

The results obtained lead to the conclusion that, in the EU, four types of areal structure of agricultural holdings can be identified:

Type I (countries of Group I) – countries with strong dominance of farms of up to 2 ha (75%) and insignificant share of the largest holdings (2%). Farms of 2-5 ha represent 13.4%. The remaining farms represent a little over 10%: 5% – holdings of 5-10 ha, 2.7% – holdings of 10-20 ha, and only 2% are farms of 20-50 ha.

Type II (countries of Group II) – countries with dominance of smaller farms, up to 5 ha,

representing almost 70% of holdings in total: the smallest farms, under 2 ha, represent, on average, 42%, and farms of 2-5 ha represent 27.3%. Holdings of 5-10 ha represent, on average, 13%, and farms of 20-50 ha and over 50 ha both represent 5% of farms.

Type III (countries of Group III) – a different type of structure is typical for countries of Group III, where approx. 1/3 of holdings have 5-20 ha, and the number of the largest holdings, of 20 ha and more, is significant (17% on average). However, these countries still have important shares of the smallest farms, of up to 5 ha, which represent almost 50%, with a relatively low share of farms under 2 ha (20%).

Type IV (Group IV, including the majority of the “old” EU member states and the Czech Republic) – countries with the highest concentration of farms of the two largest areal groups, 20-50 ha and over 50 ha. The shares of farms of these areal groups amount to 25.6% and 28.1%, respectively, being the

highest percentages of such holdings in all topological groups. In turn, the smallest farms, under 2 ha, represent only 6.2%.

The obtained results were compared with the results of research conducted before, where four areal groups were studied: 0-5 ha, 5-20 ha, 20-50 ha, over 50 ha (Table 3). Both analyses led to the identification of topological groups of different composition, although some similarities can be observed: Group IV differs in only one element (The Netherlands in Variant A belongs to Group IV, and in Variant B – to Group III); Group I from Table 2 is a subgroup of Group I from Table 3.

Both tables present a synthetic picture (characterisation) of the EU countries agrarian structure in terms of the distribution of the number of farms by areal groups. The characterisation presented in Table 3 seems clearer, and the one contained in Table 2 gives a more detailed picture of the analysed structure.

Table 3. Characteristics of topological groups with similar distribution of the number of farms in EU countries in different areal groups (Variant B), in 2013

Group	Characteristics	UAA areal groups in ha			
		<5	5-20	20-50	>50
		in %			
I: Bulgaria, Cyprus, Greece, Portugal, Romania, Hungary	Average	<b>83.7</b>	<b>11.3</b>	<b>2.8</b>	<b>2.2</b>
	s(x)	7.1	5.3	1.4	1.4
	V(x)	0.08	0.47	0.51	0.65
II: Spain, Lithuania, Latvia, Poland, Slovakia, Slovenia, Italy, Croatia	Average	<b>56.2</b>	<b>30.5</b>	<b>7.5</b>	<b>5.8</b>
	s(x)	7.2	6.0	2.5	4.0
	V(x)	0.13	0.20	0.33	0.70
III: Austria, Estonia, The Netherlands	Average	<b>30.3</b>	<b>35.3</b>	<b>20.8</b>	<b>13.6</b>
	s(x)	2.2	4.5	5.4	4.0
	V(x)	0.07	0.13	0.26	0.29
IV: Belgium, Czech Republic, Denmark, Finland, France, Ireland, Germany, Sweden, UK	Average	<b>11.8</b>	<b>33.7</b>	<b>24.8</b>	<b>30.1</b>
	s(x)	5.98	7.00	7.53	7.16
	V(x)	0.51	0.21	0.30	0.24

Source: Bożek, 2016.

An important indicator of agrarian structure, apart from the distribution of the number of farms in different areal groups, is the utilized agricultural area they represent, because it has a considerable influence on the average economic conditions of production in a given country (Babiak, 2010; Poczta,

2013). The shares of agricultural area utilized by holdings from particular areal groups in the EU countries are also strongly diversified and considerably deviate from the EU average values (Table 4). However, in this case, diversification is mostly observed in the shares of larger areal groups (starting

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from 5-10 ha). Although  $V(x)$  is the highest for farms of 0-2 and 2-5 ha (respectively, 2.33 and 1.29), it is caused by outlying data: the share of farms under 2 ha, in most

countries, rarely amount to more than 4% of total UAA; the values are incomparably higher only in Cyprus, Romania and Luxembourg.

Table 4. Utilized agricultural area in agricultural holdings by areal groups and EU countries in 2013

Country	Total (in thousand ha)	UAA areal groups in ha					
		<2	2-5	5-10	10-20	20-50	>50
		in %					
UE (28)	174,351.0	2.5	4.5	5.4	7.4	14.2	66.0
Austria	2,726.9	0.6	3.3	6.5	16.1	35.5	37.9
Belgium	1,307.9	0.1	0.9	2.8	7.6	29.6	58.9
Bulgaria	4,651	2.2	1.8	1.6	2.0	4.4	88.0
Cyprus	109.3	16.2	14.7	11.3	11.2	16.6	30.1
Czech Republic	3,491.5	0.1	0.2	1.0	1.8	4.2	92.7
Denmark	2,619.3	0.0	0.1	2.1	3.8	10.2	83.8
Estonia	957.5	0.3	1.4	3.0	5.0	8.4	82.0
Finland	2,257.6	0.0	0.4	2.0	7.2	27.4	62.9
France	27,739.4	0.2	0.7	1.1	2.3	9.6	86.2
Greece	4,856.8	6.1	11.4	12.0	12.7	15.8	42.0
Spain	23,300.2	1.2	3.2	4.3	6.6	14.2	70.6
The Netherlands	1,847.6	0.4	1.8	3.7	7.9	32.6	53.6
Ireland	4,959.4	0.1	0.5	2.4	10.3	36.0	50.8
Lithuania	2,861.3	1.3	7.5	9.4	9.8	13.0	59.0
Latvia	1,877.7	0.8	2.9	6.2	11.7	15.4	63.0
Germany	16,699.6	0.1	0.2	2.0	5.3	14.2	78.2
Poland	14,409.9	3.0	10.0	15.1	20.0	21.0	30.8
Portugal	3,641.6	3.4	5.9	6.0	7.0	10.9	66.7
Romania	13,055.9	12.1	16.4	9.9	5.0	4.4	52.1
Slovakia	1,901.6	0.4	1.1	1.0	1.7	2.5	93.3
Slovenia	485.8	4.3	16.7	24.8	22.9	18.5	12.8
Sweden	3,028.6	0.0	0.8	3.7	6.4	14.8	74.3
Hungary	4,656.5	2.5	2.9	3.8	6.0	10.5	74.3
UK	17,096.2	0.0	0.2	1.2	2.4	7.9	88.4
Italy	12,098.9	3.2	8.2	10.0	13.1	21.5	44.0
Croatia	1,571.2	3.5	9.9	10.9	11.1	13.1	51.4
Luxembourg	10.9	46.8	31.2	15.6	4.6	1.8	00
Malta	131	0.1	0.4	1.1	1.8	8.7	88.0
UE-28 average	6,226.8	3.9	5.5	6.2	8.0	15.1	61.3
$s(x)$	7,299.66	9.04	7.12	5.67	5.35	9.52	23.96
$V(x)$	1.17	2.33	1.29	0.91	0.67	0.63	0.39

Source: original calculations based on [www.europa.eu/eurostat](http://www.europa.eu/eurostat).

Based on the discussed method, the fuzzy classification of countries was conducted in terms of similarity of the above structure. As a result, the following groups of countries were identified (in brackets, the degrees of membership to the topological groups are indicated):

Group I: Cyprus (0.806), Greece (0.620), Poland (0.927), Slovenia (0.711), Italy (0.402).

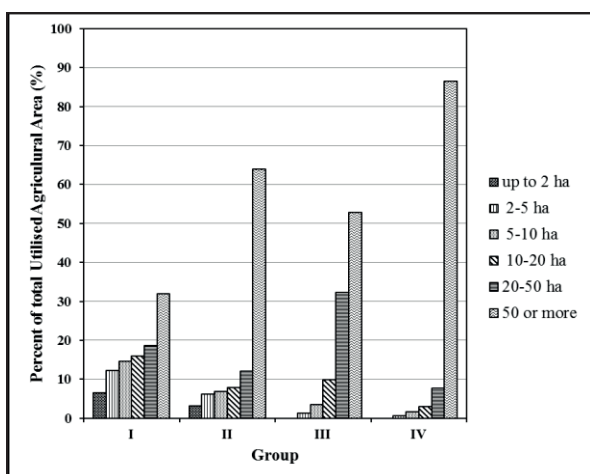
Group II: Spain (0.778), Lithuania (0.831), Latvia (0.890), Portugal (0.937), Romania (0.440), Sweden (0.528), Hungary (0.525), Croatia (0.487).

Group III: Austria (0.516), Belgium (0.846), Finland (0.600), The Netherlands (0.983), Ireland (0.907).

Group IV: Bulgaria (0.965), Czech Republic (0.920), Denmark (0.952), Estonia

(0.911), France (0.986), Germany (0.610), Slovakia (0.896), UK (0.988).

The groups' characteristics are presented in Table 5 and Figure 2. As it can be observed, the principal differentiating factor in these groups is the percentage of the UAA occupied by the largest holdings, of 20-50 ha and 50 ha and more.



Source: original work

Figure 2. Agrarian structure of topological groups

In the countries of Group I, the largest farms, of at least 50 ha, represent, on average,

32%, farms of 20-50 ha represent approx. 19% and the remaining half is divided between holdings of up to 20 ha, successively by the areal groups: 6.6%, 12.2%, 14.6%, and 16%.

Group II includes countries where farms of at least 50 ha represent, on average, approx. 64% of UAA, and farms of 20-50 ha represent approx. 12% of UAA. Farms of other areal groups represent approx. 24% (1/4) of UAA.

In the countries of Group III, farms of at least 50 ha represent over half of UAA, 32.2% is utilised by farms of 20-50 ha, and farms of less than 5 ha represent only 1.7% of the total UAA.

In Group IV are categorised countries with substantial dominance of the largest holdings, of at least 50 ha, representing approx. 87% of UAA, and where the shares of holdings of under 10 ha are insignificant (only 2.7% of UAA).

The results obtained were compared with the previous research results, in which four areal groups were adopted: up to 5 ha, 5-20 ha, 20-50 ha, 50 ha and more (Table 6).

Table 5. Characteristics of groups of countries with similar distribution of UAA by areal groups (Variant A) in 2013

Group	Characteristics	UAA areal groups, in ha					
		<2	2-5	5-10	10-20	20-50	>50
		in %					
I: Cyprus, Greece, Poland, Slovenia, Italy	Average	<b>6.6</b>	<b>12.2</b>	<b>14.6</b>	<b>16.0</b>	<b>18.7</b>	<b>31.9</b>
	s(x)	4.9	3.1	5.4	4.6	2.3	11.1
	V(x)	0.75	0.25	0.37	0.29	0.12	0.35
II: Spain, Lithuania, Latvia, Portugal, Romania, Sweden, Hungary, Croatia	Average	<b>3.1</b>	<b>6.2</b>	<b>6.8</b>	<b>8.0</b>	<b>12.0</b>	<b>63.9</b>
	s(x)	3.6	4.7	2.7	2.4	3.3	8.6
	V(x)	1.16	0.77	0.40	0.30	0.27	0.13
III: Austria, Belgium, Finland, The Netherlands, Ireland	Average	<b>0.3</b>	<b>1.4</b>	<b>3.5</b>	<b>9.8</b>	<b>32.2</b>	<b>52.8</b>
	s(x)	0.2	1.1	1.6	3.3	3.3	8.5
	V(x)	0.93	0.77	0.46	0.34	0.10	0.16
IV: Bulgaria, Czech Republic, Denmark, Estonia, France, Germany, Slovakia, UK	Average	<b>0.4</b>	<b>0.7</b>	<b>1.6</b>	<b>3.0</b>	<b>7.7</b>	<b>86.6</b>
	s(x)	0.7	0.6	0.7	1.4	3.6	4.8
	V(x)	1.75	0.87	0.41	0.45	0.47	0.06

Source: original calculations.

When comparing Tables 5 and 6, it can easily be observed that in both cases the topological groups have a very similar composition. Groups I and III are identical, and differences in the composition of Groups

II and IV relate to only two countries: Sweden and Hungary, in Variant A, belong to Group II, and in Variant B – to Group IV. Therefore, when it comes to utilised agricultural area, distinguishing the smallest

areal group of farms does not influence the composition of groups, but the obtained picture of the analysed structure is more accurate. The results of the research show that the grouping of countries in terms of similarity in distribution of the number of farms gives different results than grouping by

the distribution of UAA. However, in general, countries with high percentage of small farms are classified as countries with large fragmentation of UAA. This is particularly visible in Variant B classifications.

Table 6. Characteristics of groups of EU countries with similar distribution of UAA by areal groups (Variant B), in 2013

Group	Characteristics	UAA areal groups, in ha			
		<5	5-20	20-50	>50
		in %			
I: Cyprus, Greece, Poland, Slovenia, Italy	Average	<b>18.8</b>	<b>30.6</b>	<b>18.7</b>	<b>31.9</b>
	s(x)	6.95	9.72	2.30	11.12
	V(x)	0.37	0.32	0.12	0.35
II: Spain, Lithuania, Latvia, Portugal, Romania, Croatia	Average	<b>11.4</b>	<b>16.3</b>	<b>11.8</b>	<b>60.5</b>
	s(x)	8.34	3.78	3.58	7.08
	V(x)	0.74	0.23	0.30	0.12
III: Austria, Belgium, Finland, The Netherlands, Ireland	Average	<b>1.7</b>	<b>13.3</b>	<b>32.2</b>	<b>52.8</b>
	s(x)	1.31	4.78	3.31	8.54
	V(x)	0.80	0.36	0.10	0.16
IV: Bulgaria, Czech Republic, Denmark, Estonia, France, Germany, Slovakia, Sweden, Hungary, UK	Average	<b>1.5</b>	<b>5.7</b>	<b>8.7</b>	<b>84.1</b>
	s(x)	1.69	2.75	3.89	6.56
	V(x)	1.13	0.48	0.45	0.08

Source: Božek, 2016.

## CONCLUSION

1. The agrarian structure of the EU countries is strongly diversified. In terms of the number of agricultural holdings in the selected areal groups, four types of structure can be distinguished:

– countries with dominance of very small farms, of up to 2 ha, representing 75% of the total number of farms, where the largest farms, of 50 ha and more, represent only 2%. These include: Bulgaria, Cyprus, Romania, and Hungary.

– in Greece, Portugal, Slovakia and Croatia, the largest farms also constitute a low percentage (approx. 5%); small farms, of up to 5 ha, represent 60%, and the smallest farms, of up to 2 ha, approx. 42% of all farms.

– a different type of agrarian structure is observed in Austria, Estonia, Spain, Lithuania, Latvia, Poland, Slovenia and Hungary, where 1/3 are holdings have 5-20 ha, with significant shares of the largest farms, over 20 ha (17% on average); still, the smallest farms, of up to 5 ha, represent

approx. 50% of farms, with relatively low shares of farms under 2 ha (20%).

– in the majority of the UE-15 countries (Belgium, Denmark, Finland, France, The Netherlands, Ireland, Germany, Sweden, UK) and the Czech Republic one can observe the highest concentration of farms of the largest areal groups, that is, 20-50 ha and over 50 ha (the shares of such farms amount to, respectively, 25.6% and 28.1%, and that is the highest percentage of such holdings in all topological groups). The smallest farms, in turn, represent only 6.2%.

2. In terms of the percentage of agricultural area utilised by holdings from different areal groups, significant differences can be observed in the largest farms, of 20-50 ha and over 50 ha. The following types of the analysed structure can be distinguished:

– countries where half of the land is occupied by holdings of up to 20 ha, the largest farms, of at least 50 ha, represent, on average, 32%, and farms of 20-50 ha – 19% of UAA. Such distribution is typical for Cyprus, Greece, Poland, Slovenia and Italy.



– countries where farms over 50 ha represent, on average, approx. 64% of UAA, and farms of 20-50 ha – approx. 12%. The remaining farms represent, on average, approx. 24% (1/4) of UAA. Such countries include: Spain, Lithuania, Latvia, Portugal, Romania, Sweden, Hungary, and Croatia.

– countries where farms over 50 ha represent over half of UAA, farms of 20-50 ha represent 32.2%, and farms of up to 5 ha – only 1.7% of UAA. Such structure can be observed in: Austria, Belgium, Finland, The Netherlands, and Ireland.

– countries with considerable dominance of the largest holdings, of at least 50 ha, which occupy approx. 87% of UAA, with insignificant shares of farms under 10 ha (only 2.7% of UAA). These countries include: Bulgaria, Czech Republic, Denmark, Estonia, France, Germany, Slovakia, and UK.

## REFERENCES

- Babiak, J., 2010. *Zmiany w strukturze rolnictwa krajow Unii Europejskiej*. Roczniki Integracji Europejskiej, 4: 87-97.
- Bogocz, D., Bozek, J., Kukul,a K., Strojny, J., 2010. *Statystyczne studium struktury agrarnej w Polsce*. PWN, Warszawa: 92-117.
- Bożek, J., Bozek, B., 2011. *Typologia struktury agrarnej wojewodstw w ujeciu dynamicznym z zastosowaniem klasyfikacji rozmytej*. Metody ilosciowe w badaniach ekonomicznych, II/2, Wydawnictwo SGGW, Warszawa, 2011: 91-100.
- Bożek, J., 2013. *Klasyfikacja podregionow pod wzgledem podobienstwa struktury agrarnej*. Wiadomosci Statystyczne, 9: 1-16.
- Bożek, J., Kukula, K., Bogocz, D., 2009. *Taxonomic analysis of areal structure of farms in Poland 2000-2007*. Metody ilosciowe w badaniach ekonomicznych, X, Wydawnictwo SGGW, Warszawa: 50-57.
- Bożek, J., 2013. *Taksonomia struktury agrarnej podregionow Polski dla dwoch wariantow klas obszarowych gospodarstw*. Hradeckie ekonomicke dny 2013, vol.1, Hradec Kralove: Gaudeamus 2013, ISBN 978-80-7435-249-2: 63-69.
- Bożek, J., 2016. *Klasyfikacja krajow UE pod wzgledem podobienstwa struktury agrarnej*. Zeszyty Naukowe SGGW w Warszawie, Problemy Rolnictwa Swiatowego, tom 16 (XXXI), z.1: 36-47.
- Eurostat. Farm Structure survey 2013 – main results (2015): Main Tables and Database.
- Falkowski, J., Kostrowicki, J., 2001. *Geografia rolnictwa swiata*. PWN, Warszawa.
- Grabinski, T., 1992. *Metody aksonometrii*. Akademia Ekonomiczna w Krakowie, Krakow, 1992.
- Jajuga, K., 1984. *Zbiory rozmyte w zagadnieniu klasyfikacji*. Przegląd Statystyczny, z.3/4: 237-290.
- Pociecha, J., Podolec, B., Sokolowski, A., Zajac, K., 1988. *Metody taksonomiczne w badaniach spoleczno-ekonomicznych*. PWN, Warszawa, 1988.
- Poczta, W., 2013. *Gospodarstwa rolne w Polsce na tle gospodarstw Unii Europejskiej – wpływ WPR*. (praca zbiorowa pod kier. W. Poczty), GUS, Warszawa, 2013.
- Popescu, A., Condei, R., 2015. *Research on Romania's employment in agriculture and its position in the European Union*. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 15, 2: 281-290.
- Stanko, S., Mikula, A., 2016. *Zmiany struktury obszarowej gospodarstw rolnych w krajach UE-15 i w Polsce*. Problemy Rolnictwa Swiatowego, tom 16 (XXXI), z.1, 2016: 234-244.
- Timofti, E., Popa, D., Kielbasa, B., 2015. *Comparative analysis of the land fragmentation and its impact on the farm management in some EU countries and Moldova*. Journal Scientific Papers Series Management, Economic Engineering and Rural Development, University of Agricultural Sciences and Veterinary Medicine Bucharest Romania, vol. 15, issuse 9, Print ISSN 2284-8000: 345-356.