

## COMPARISON OF ENROLMENT IN HIGHER AGRICULTURAL EDUCATION IN POLAND AND OTHER EUROPEAN UNION COUNTRIES FROM 2013–2017

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### ABSTRACT

The aim of the article is to identify changes in the level of enrolment in higher agricultural education in Poland compared with other European Union countries in the years 2013–2017. An additional aspect of study was the causal relationship between the number of people undertaking higher agricultural education and the effectiveness of the functioning of agriculture in a given country. The dynamics ratio was used to present the existing tendencies. Additionally, admissions for individual types of studies were examined and the differences in values from individual countries were presented. Spearman's coefficient of rank correlation was used to analyze the causative relationship. Poland belongs to a group with relatively low levels of higher agricultural studies. In addition, the number of persons undertaking education at agricultural universities is closely connected with the efficiency of agriculture in a given European Union country.

**Key words:** agriculture, knowledge, education, higher education, enrolment, Poland, EU

**JEL codes:** I21, I23, J24, Q10

### INTRODUCTION

Modern economy is based on the effective use of existing human potential. Human resources are the source of achieving success by the proper use of acquired knowledge or gained experience. Obtained information may be transformed into intelligence aimed at solving problems as well as supporting others in acquiring and sharing the knowledge [Fitzenz 2001]. Thus, a human being is an important factor of competitive advantage.

Of particular importance in this aspect is improvement in the quality of intellectual resources which, as noted by Borowiec, depends on how well the education system functions [Borowiec 2011]. The process of gaining an education is significant not only because

of the level of knowledge that is achieved but also because education is closely connected with a field of study and influences the effective functioning of the job market.

The completion of higher education studies in agriculture is very important to the agricultural sector. The global economy has created a growing challenge for companies that must operate under conditions of high competition in agribusiness and the food industry. Since Poland's accession to the European Union, competition in this arena has developed significantly, and Polish companies, after restructuring during the transformation period, have begun to modernize in terms of organization and management [Firlej 2009a]. The functioning of the modern agri-food industry is undoubtedly the most important element of agribusi-

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ness because its task is to secure perishable plant and animal raw materials, and to transform them into more durable and safe products for consumption [Firlej 2009b]. This requires high qualifications and professional competence. Knowledge acquired during university studies are focused primarily on the proper management of agricultural enterprises, the ability to obtain subsidies, how to make rational investment decisions, and how to optimize work organization in agriculture. According to Firlej and Kubala [2018], agricultural enterprises managed by people who have completed a level of higher education will achieve a higher level of efficiency. At the same time, such managers will use the resources available within their activities more effectively. As is pointed out by Maguire [2004], the agricultural education system has been a major contributor to agricultural research, production and institutional successes. Parr et al. [2007] also emphasize that education in sustainable agriculture is beginning to emerge as a way to address many complex social and environmental problems.

Addressing problems related to the education of future farmers is very significant nowadays, especially due to an observed decrease in employment in agriculture among young people. The issue of higher education in agriculture have been addressed by, among others, Francis et al. [2000], Gołębiewska and Klepacki [2005], Mulder [2005], Parr [2011], Boguski [2012], Rudnicki [2013], Baggett et al. [2015], Firlej [2017], Firlej and Kubala [2018]. Another research topic is the relationship between agricultural education and agricultural efficiency, addressed by such authors as Huffman [1999], Krzyżanowska [2000], Wołoszyn [2002], Wiatrak [2005] and Kołoszko-Chomentowska [2008]. The existing studies, however, do not deal with enrolment in higher agricultural education in the member states of the European Union, which is the focus of this research paper.

## **MATERIAL AND STUDY METHODOLOGY**

The aim of the article is to identify changes in the level of enrolment in higher agricultural education in Poland compared with other European Union countries in the years 2013–2017. An additional aspect was to study whether there is a causal relationship between

the number of people who undertake higher agricultural education and the effectiveness of a country's system of agriculture, which was presented with the use of agriculture added value (in millions of dollars). As noted by Poczta and Kołodziejczak [2008], agriculture added value is one of the basic measures of diversifying the productivity of agriculture. The need to study this relationship has been discussed by Porceddu and Rabbinge [1997], who emphasized that agricultural education in Europe has an important role in agricultural efficiency. Coleman et al. [2004] describe knowledge as the main factor influencing the efficiency of farms and Nowak et al. [2016] point to the existing gaps in research between the level of education and agricultural productivity.

Two variables were adopted to present the existing tendencies: the number of newly admitted students to Bachelor's and Master's degree agricultural studies, and that same number compared with the total number of newly admitted students. To analyze the first variable, the dynamics ratio between 2013 and 2017 was used, as well as admissions for individual types of studies in 2013 and 2017 compared with other member states. The dynamic ratio was the percentage ratio of the number of newly admitted students to agricultural studies in 2017 and the level of this variable in 2013. Determining the share focused on expressing the percentage of students in individual countries admitted in agricultural studies in the total number of students undertaking this type of study in the European Union. To describe the changes for the second variable the differences in their values between 2013 and 2017 were used.

At the same time, groups of countries characterized by a similar level of number of people newly admitted to Bachelor's and Master's degree agricultural studies compared with the total number of the newly admitted students in the analyzed period were selected. The Ward's method was used, which is regarded as an agglomeration method and based on the analysis of variance aimed at minimizing the sum of the squared deviations in clusters. The Spearman's coefficient of rank correlation between the number of people undertaking higher agricultural education and the added value of agriculture was used to analyze the causative relationship. This coefficient is used to

describe the strength of correlation of two features when the features are measurable and the examined population is small, and when the features are of a qualitative nature and it is possible to order them. Spearman's rank correlation coefficient takes values from the range  $<-1, +1>$ . The closer it is to  $+1$  or  $-1$ , the stronger the relationship.

The data required for calculations was gathered from the Eurostat database for the years 2013–2017. The study period was dictated by the access to the data concerning the analyzed aspects. Croatia, France and Ireland were not included into the study due to the lack of statistical data. Country codes in the tables and the figures comply with ISO 3166-1. The calculations were conducted in Statistica v. 13 program.

## STUDY RESULTS

Diverging trends may be observed in the total number of students newly admitted to agricultural Bachelor's degree studies between 2013 and 2017 (Table 1). There was a slight increase in their number by 4.11% between 2013 and 2014. Over the next few years, a gradual decrease is visible. Compared to 2014, in 2017 the number of newly admitted agricultural enrollees in the European Union dropped by 3,515 students – 7.05%.

In 2013, the largest number of students admitted to agricultural Bachelor's degree studies was in Italy (16.48%), followed by Germany (15.36%) and Poland (11.85%). A relatively high number of agricultural students (over 5%) were also admitted in the Czech Republic, Great Britain, Greece and Romania. Admissions below 1% were recorded in seven countries, the lowest being in Cyprus, Malta and Luxembourg.

Similar tendencies were observed in 2017. The highest number of students admitted to agricultural Bachelor's studies was also found in Italy, followed by Germany and Poland. However, while in the first two countries an increase was recorded between 2013 and 2017 (to 17.69 and 15.36%), a decrease to 9.88% was observed in Poland. Subsequently, the highest admissions (over 5%) were in Romania, Great Britain, Greece and the Czech Republic. Admissions below 1% were recorded in eight countries, the lowest in

Cyprus, Malta and Luxembourg. The largest increase of admitted agricultural students between 2013 and 2017 was observed in Romania (by 3.39%), while the biggest drops were in the Czech Republic (by 3.15%) and Poland (by 1.97%).

Considering the dynamics between 2013 and 2017, it should be emphasized that an increase of new Bachelor's agricultural students was recorded only in eight countries. The highest growth was observed in Cyprus and Romania (by 95.83 and 52.98%, respectively). In the remaining countries there were declining tendencies, the largest in the Czech Republic, Latvia and Estonia. There was a relatively high decrease of the newly admitted in Poland, where between 2013 and 2017 the dynamics was at the level of 80.66%, and as a consequence it was the 7th biggest drop of the analyzed phenomenon in this period.

Taking into account the number of students newly admitted to Master's degree studies in the years 2013–2017, diverging trends may be also observed (Table 2). Between 2013 and 2014, as well as in 2015 and 2016, a slight growth was recorded. Over the next years there was a decrease in the number of persons undertaking agricultural Master's degree studies. Between 2013 and 2017 an increase of 4.21% was observed.

In 2013, the largest number of admissions at this educational level were in Germany and Poland (15.89 and 14.54% of the total number of the students newly admitted to Master's degree studies in the EU). Relatively high admissions (over 5%) were found in Romania, Italy, the Czech Republic, Spain and Great Britain. On the other hand, admissions lower than 1% were recorded in six countries (the lowest admissions were, similarly as in the case of Bachelor's degree studies, in Luxembourg, Cyprus and Malta).

Changes took place in 2017, where the largest number of admissions were observed in Germany, Italy and Romania (12.49–16.68% of the total number of students newly admitted to Master's degree studies). The subsequent biggest admissions were in Poland, Great Britain, Spain and the Czech Republic. Admissions below 1% were recorded in seven countries (the lowest admissions were in the same countries as in 2013). The biggest growth of admissions between 2013 and 2017 was in Italy, Great Britain and

**Table 1.** Characteristics and changes in the number of students newly admitted to agricultural Bachelor’s degree studies in the years 2013–2017

Item	2013 persons	2014 persons	2015 persons	2016 persons	2017 persons	Share 2013 (%)	Share 2017 (%)	Dynamics ratio 2017/2013 (%)
AT	386	351	393	329	330	0.81	0.71	85.49
BE	2 370	2 480	1 983	2 122	2 289	4.95	4.94	96.58
BG	1 318	1 303	1 247	1 112	990	2.75	2.14	75.11
CY	24	21	30	33	47	0.05	0.10	195.83
CZ	4 035	3 419	2 663	2 397	2 443	8.42	5.27	60.55
DE	7 212	7 752	7 582	7 275	7 121	15.05	15.36	98.74
DK	305	318	339	367	389	0.64	0.84	127.54
EE	199	180	160	150	132	0.42	0.28	66.33
ES	2 153	2 077	1 851	1 656	1 691	4.49	3.65	78.54
FI	898	841	739	636	815	1.87	1.76	90.76
GB	3 674	4 284	4 125	4 308	4 040	7.67	8.71	109.96
GR	2 919	3 387	3 351	3 194	3 399	6.09	7.33	116.44
HU	1 133	1 121	1 030	848	1 198	2.36	2.58	105.74
IT	7 898	8 552	7 951	8 371	8 204	16.48	17.69	103.87
LT	717	701	895	866	660	1.50	1.42	92.05
LU	0	0	0	0	0	0.00	0.00	×
LV	325	423	239	221	209	0.68	0.45	64.31
MT	0	13	7	28	40	0.00	0.09	×
NL	1 196	1 257	1 275	1 239	1 320	2.50	2.85	110.37
PL	5 677	5 306	4 897	4 955	4 579	11.85	9.88	80.66
PT	785	864	893	971	622	1.64	1.34	79.24
RO	2 799	3 291	4 400	4 961	4 282	5.84	9.24	152.98
SE	503	526	472	510	423	1.05	0.91	84.1
SI	572	608	563	506	466	1.19	1.01	81.47
SK	816	807	856	760	678	1.70	1.46	83.09
EU	47 914	49 882	47 941	47 815	46 367	100.00	100.00	96.77

Source: Authors’ own studies based on Eurostat.

Romania (respectively, by 3.62, 2.77 and 2.68%). On the other hand, the biggest fall in admissions in that period was in the Czech Republic and Poland (respectively, by 3.28 and 5.61%).

Taking into account the dynamics between 2013 and 2017, it should be emphasized that an increase of students newly admitted to agricultural Master’s degree studies was recorded in 12 countries. The highest

**Table 2.** Characteristics and changes in the number of students newly admitted to agricultural Master’s degree studies in the years 2013–2017

Item	2013 persons	2014 persons	2015 persons	2016 persons	2017 persons	Share 2013 (%)	Share 2017 (%)	Dynamics ratio 2017/2013 (%)
AT	401	362	339	349	341	1.64	1.34	85.04
BE	887	1 031	974	1 016	1 108	3.63	4.35	124.92
BG	599	881	682	730	651	2.45	2.56	108.68
CY	13	7	8	8	15	0.05	0.06	115.38
CZ	2 056	1 542	1 385	1 426	1 307	8.41	5.13	63.57
DE	3 882	4 314	4 417	4 509	4 247	15.89	16.68	109.4
DK	333	354	303	373	359	1.36	1.41	107.81
EE	144	129	110	141	128	0.59	0.50	88.89
ES	2 054	2 015	2 151	2 401	1 954	8.41	7.67	95.13
FI	124	181	143	133	155	0.51	0.61	125.00
GB	1 433	1 880	2 107	1 906	2 198	5.86	8.63	153.38
GR	432	361	291	437	428	1.77	1.68	99.07
HU	675	541	615	632	628	2.76	2.47	93.04
IT	2 260	2 441	2 903	2 883	3 277	9.25	12.87	145.00
LT	318	249	266	278	292	1.30	1.15	91.82
LU	29	3	3	42	33	0.12	0.13	113.79
LV	56	62	133	138	127	0.23	0.50	226.79
MT	0	0	0	0	0	0.00	0.00	x
NL	591	662	682	756	710	2.42	2.79	120.14
PL	3 554	3 173	2 787	2 593	2 275	14.54	8.93	64.01
PT	934	948	767	885	917	3.82	3.60	98.18
RO	2 398	2 714	2 543	3 074	3 181	9.81	12.49	132.65
SE	339	347	359	337	335	1.39	1.32	98.82
SI	260	231	248	245	174	1.06	0.68	66.92
SK	665	681	647	633	625	2.72	2.45	93.98
EU	24 437	25 109	24 863	25 925	25 465	100.00	100.00	104.21

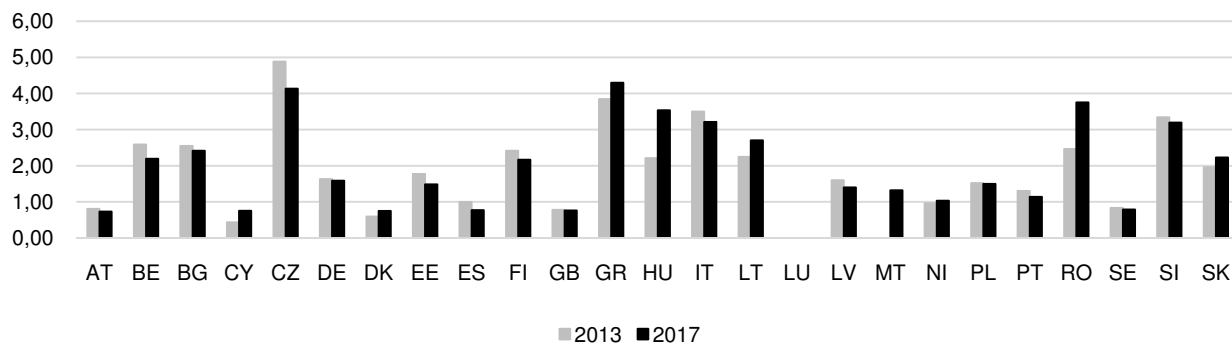
Source: Authors’ own studies based on data Eurostat.

growth was in Latvia, Great Britain and Italy (126.79, 53.38 and 45%, respectively). In the case of other EU countries declining trends were recorded, the highest in the Czech Republic, Poland and Slovenia.

An important index that shows the changing admissions to higher agricultural education in the European Union is the ratio of new agricultural students to the total number of students newly admitted to higher

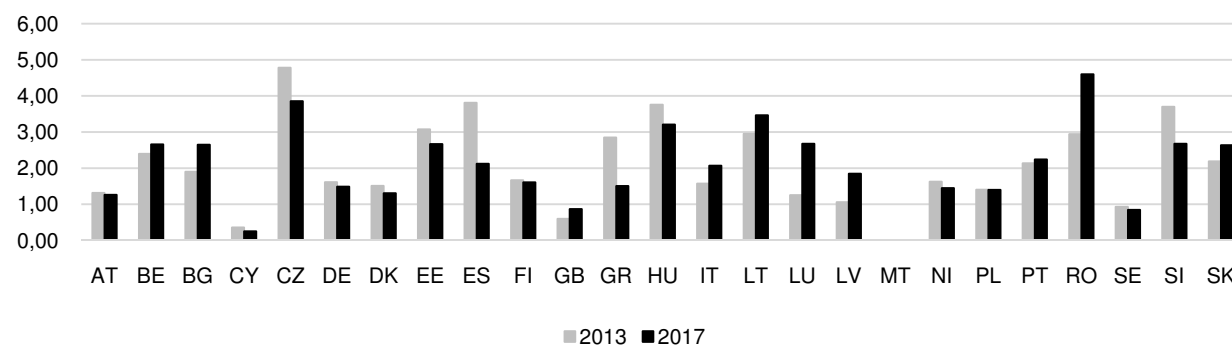
education studies. In the analysis of Bachelor's studies (Fig. 1) in 2013, the highest level of the index was in the Czech Republic, Greece, Italy and Slovenia (from 3.34 to 4.88%). The admissions in Poland were 1.52%, which was the 15th position among the analyzed European Union countries. In 2017 the largest admissions were observed in Greece, while the Czech Republic dropped to the second position. There was a significant increase of admissions during these years in Hungary (1.33%) and Romania (1.29%), which put them in third and fourth place with the largest admissions. A growth in admissions during these years was observed in nine countries. The biggest decrease of the index value between 2013 and 2017 was in the Czech Republic and Belgium (by 0.75 and 0.40%). In Poland the admissions value slightly declined by 0.02%.

In the analysis of the Master's degree studies (Fig. 2) in 2013, the highest level of the index – as in the case of Bachelor's degree studies – was in the Czech Republic (4.78%). Next positions were occupied by Spain, Hungary and Slovenia (from 3.70 to 3.81%). The admissions in Poland in that year were 1.41%, which was the 19th position among the analyzed European Union countries. In 2017 the largest admissions were recorded in Romania, then the Czech Republic, Lithuania and Hungary. Poland was in the 20th position. An increase of admissions during these years was found in ten countries. The biggest decrease of the index value between 2013 and 2017 was in Spain, Greece, Slovenia and the Czech Republic. In Poland a drop in admissions by 0.01% was recorded.



**Fig. 1.** The share of newly admitted students to agricultural Bachelor's degree studies compared with those newly admitted to all higher education studies (%)

Source: Author's own studies based on Eurostat.



**Fig. 2.** The share of newly admitted students to agricultural Master's degree studies compared with those newly admitted to all higher education studies (%)

Source: Author's own studies based on Eurostat.

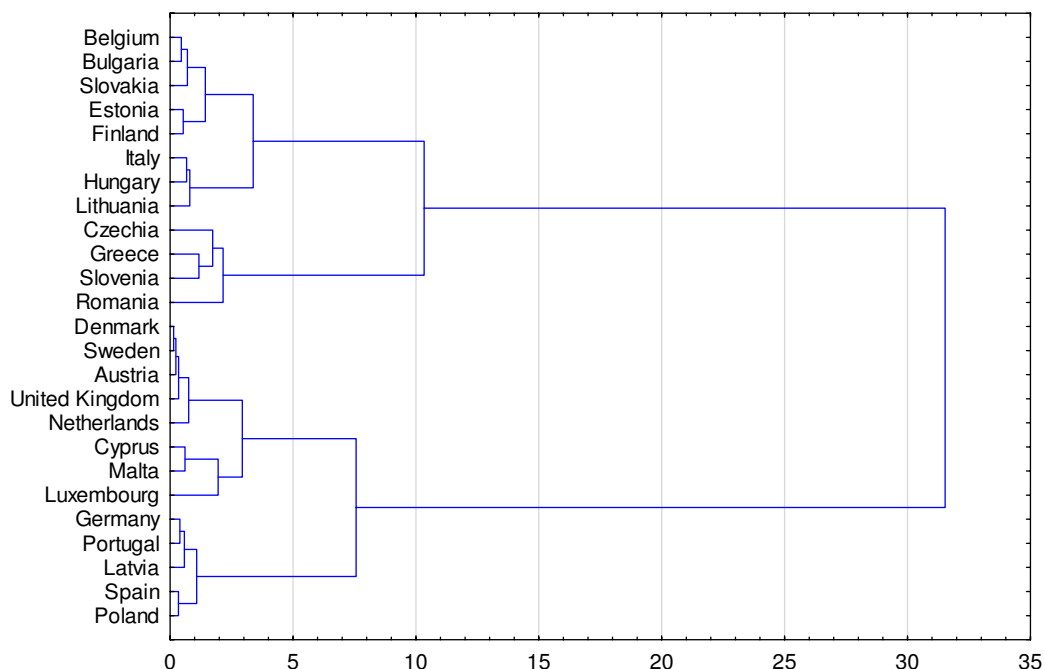
The Ward method was used to select a group of European Union countries with similar levels of newly admitted Bachelor’s and Master’s agricultural students, compared with the total number of newly admitted students in the analyzed period. On the basis of the analysis of the horizontal tree chart (Fig. 3), it was concluded that the closest to the vertical axis are Denmark and Sweden. They are joined by Austria, Great Britain and the Netherlands. Cyprus, Malta and Luxembourg are also connected with this group of countries. The second cluster includes Poland and Spain, joined by Germany and Portugal and at a further distance, Latvia. The next group consists of Belgium and Bulgaria, which are connected with Slovakia at a further distance. The cluster is joined by Estonia and Finland and subsequently Italy, Hungary and Lithuania. A separate group represents Greece and Slovenia, with the Czech Republic and Romania in the longer distance.

An additional aspect of the study was to conduct research aimed at presenting the cause and effect rela-

tionships between the number of persons undertaking higher agricultural education and the economic effectiveness of the functioning of agriculture in a given country. The added value in agriculture is shown in Table 3.

The highest level of added value in agriculture in all years was observed in Italy, Spain, Germany and Great Britain. A relatively high level was recorded in the research period in Poland (which had the highest among EU countries from Central and Eastern Europe). Between 2013 and 2017 an increase in value was noted in four countries, the largest in Denmark and Spain. In Poland, the value added of agriculture decreased between 2013 and 2017 by 2.87%.

During calculations, observations were ranked from highest to lowest. The lowest value of the calculated indicator is for the year 2013 and amounts to 0.802 (Table 4). In the remaining years the correlation index fluctuates from 0.825 to 0.884, which proves the existence of a very strong relationship between the analyzed variables.



**Fig. 3.** Dendrogram of a group of European Union countries differentiated by the number of students newly admitted in agricultural studies compared with the total number of newly admitted students

Source: Author’s own studies based on Eurostat.

**Table 3.** Value added in agriculture years 2013–2017 (millions USD)

Item	2013	2014	2015	2016	2017
AT	5 396	5 307	4 314	4 385	5 010
BE	3 584	3 447	3 186	2 982	3 277
BG	2 562	2 590	2 077	2 159	2 370
CY	484	427	364	394	406
CZ	5 033	5 141	4 162	4 028	4 443
DE	32 981	34 075	22 072	23 289	28 704
DK	4 474	4 880	2 898	3 109	4 707
EE	752	799	613	515	637
ES	34 188	33 513	31 208	33 291	35 311
FI	6 933	6 546	5 174	5 689	5 930
GB	18 063	19 449	17 076	15 457	15 636
GR	7 693	8 054	7 464	6 984	7 520
HU	5 208	5 557	4 605	4 879	5 247
IT	44 631	41 761	37 004	35 179	37 164
LT	1 661	1 662	1 428	1 322	1 481
LU	171	192	131	132	165
LV	992	1 047	983	888	973
MT	120	127	116	120	123
NL	15 705	15 488	13 196	13 841	15 400
PL	15 066	14 246	10 513	11 238	14 634
PT	4 703	4 659	4 089	4 030	4 336
RO	10 338	9 426	7 446	7 673	9 259
SE	7 097	6 822	5 987	5 739	5 717
SI	865	1 006	883	868	829
SK	3 565	4 075	2 964	3 022	2 960

Source: Author's own studies based on Eurostat.

**Table 4.** The relationship between economic effectiveness and the number of newly admitted students

Year	Spearman's rank correlation coefficient
2013	0.802
2014	0.825
2015	0.841
2016	0.833
2017	0.844

Source: Author's own studies based on Eurostat.



The significance of the calculated factors was also proved. Due to the small number of observations during the testing of the null hypothesis, their accurate distribution was used. In all cases the null hypothesis, stating that there is a lack of correlation between the analyzed variables, was rejected for the benefit of the alternative hypothesis indicating that there is a correlation and it is positive.

## SUMMARY AND FINAL CONCLUSIONS

The agriculture industry today is facing great challenges resulting from the need to properly modernize the processes of agricultural enterprises, to obtain subsidies in order to develop the industry, and to meet the high demands imposed on agricultural producers. Therefore, it is necessary to take measures to help shape the people who undertake higher agricultural education. This in turn may bring an indirect increase in the work efficiency in agriculture. The conducted study presents the situation of students newly admitted to higher agricultural studies in the European Union and allows to come to the following conclusions:

1. One of the main problems of the future of agriculture in the European Union is the decreasing tendency of students to enroll in higher agricultural studies. Regarding the admissions to Bachelor's degree studies between 2013 and 2017, this tendency was observed in 15 European Union countries, and in the case of Master's degree studies, in 12 countries. One of the largest decreases in enrolment was observed in Poland (the 7th largest fall of admissions to Bachelor's degree studies and the second to Master's degree studies).
2. When considering the relationship between the number of newly admitted persons to higher agricultural studies and the total number of newly admitted students to higher education studies, it can be concluded that higher agricultural education has the highest values in the Czech Republic, Romania, Hungary (with regard to Bachelor's degree and Master's degree studies), Greece, Italy and Slovenia (with regard to Bachelor's degree studies) and Lithuania (with regard to Master's

degree studies). Higher agricultural studies have the lowest values in Cyprus, Great Britain and Sweden. However, between 2013 and 2017, an increase in the importance of higher agricultural studies admissions in the total number of admissions may be observed in nine countries (Bachelor's degree studies) and in 10 countries (Master's degree studies).

3. On the basis of the selected groups of European Union countries with similar levels of people newly admitted to Bachelor's and Master's degree agricultural studies, compared with the total number of newly admitted students, it may be stated that Poland belongs to the group with a relatively low level of higher agricultural studies preference. Additionally, the admissions in Poland are one of the lowest among the member countries in Central and Eastern Europe. The highest importance of higher agricultural studies is in the Czech Republic, Greece, Romania and Slovenia. An increase in the number of students undertaking these studies in the analyzed period may be observed in Greece and Romania, however, in the Czech Republic and in Slovenia, in spite of the year-to-year decrease in newly admitted students, there are still high admissions.
4. The number of persons undertaking education at agricultural universities is closely connected with the agricultural efficiency in a given European Union country, which means that in countries with a significant percentage of persons undertaking higher agricultural education, a high ability to transform the workload into efficiency is recorded. However, there are limitations associated with this method, mainly due to a lack of statistical data. The key issue is to gain knowledge about the education that farmers in each country have, and what percentage of people completing agricultural studies work in agriculture.

## Acknowledgements

The article is financed within the subsidy granted to the Cracow University of Economics. Program Potencjał No 13/EER/202/POT.

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## **TENDENCJE W PODEJMOWANIU STUDIÓW ROLNICZYCH W POLSCE NA TLE KRAJÓW UNII EUROPEJSKIEJ W LATACH 2013–2017**

### **STRESZCZENIE**

Celem artykułu jest identyfikacja zmian w poziomie podejmowania wyższego wykształcenia rolniczego w Polsce w porównaniu z krajami Unii Europejskiej w latach 2013–2017. Dodatkowym aspektem było zbadanie związku przyczynowego między liczbą osób podejmujących wyższe wykształcenie rolnicze a efektywnością funkcjonowania rolnictwa w danym kraju. Wskaźnik dynamiki wykorzystano do przedstawienia istniejących tendencji. Dodatkowo zbadano przyjęcia na poszczególne rodzaje studiów oraz przedstawiono różnice w wartościach w poszczególnych krajach Unii Europejskiej. Do analizy związku przyczynowego wykorzystano współczynnik korelacji rang Spearmana. Polska należy do grupy o stosunkowo niskim poziomie podejmowania studiów rolniczych. Ponadto liczba osób kształcących się na uniwersytetach rolniczych jest ściśle związana z efektywnością rolnictwa w danym kraju Unii Europejskiej.

**Słowa kluczowe:** rolnictwo, wiedza, edukacja, szkolnictwo wyższe, nabór, Polska, UE

