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## **THE POSITION OF POLAND AS A CEREAL PRODUCER IN COMPARISON WITH OTHER EU COUNTRIES**

**Summary:** The aim of the article is to compare the Polish cereal market with the EU market, based on the production of 4 of the most popular cereals: barley, oats, rye and wheat. The article presents Poland as one of the largest producers against selected European Union countries in 2004-2014. The choice of other countries depended on the size of the cereal market. Correlation between cereal prices was also presented. The study period covers many changes in agriculture related to entering the Community, adapting to the standards and the first decade of their functioning. Poland is one of the largest cereal producers selected for analysis in the European Union. However, their prices in individual countries are characterized by high correlation.

**Key words:** cereal market, European Union, cereals, Poland.

### **1. INTRODUCTION**

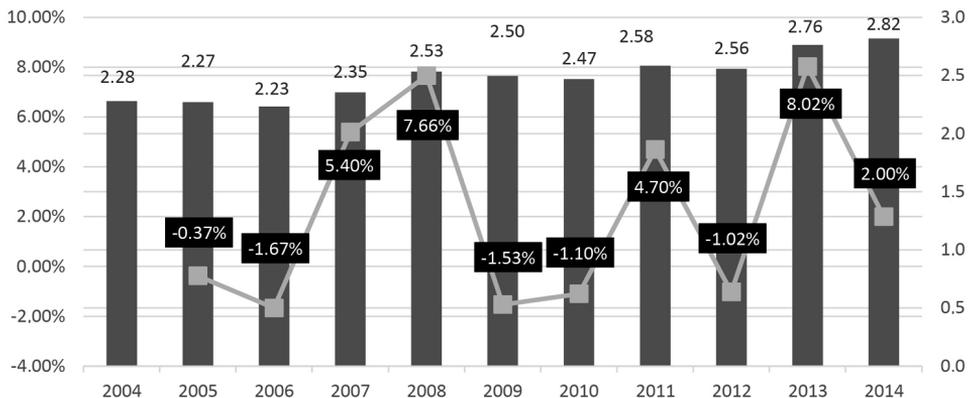
Agriculture is an economic sector, which is sometimes recognised as a special one. It is distinguished by the immobility (massiveness) of the soil factor, as well as the impact of natural conditions (including temperature and the height of groundwater level), agricultural suitability of soil, the structure of cultivated land and the afforestation rate [Woś, Tomczak 1983]. Another distinguishing feature is the development paradox of agriculture, which occurs despite the emergence of more productive plant varieties and animal breeds – farmers' situation is deteriorating because the food demand is not flexible [Tracy, 1993]. What is more, agriculture is characterised by positive externalities. They largely result from the connection between agriculture and the natural environment. The functioning of agriculture considerably contributes to the protection of natural resources as well as the maintenance of tradition, culture and manners of food production [Smędzik-Ambroży 2016, p. 79-80].

The above-mentioned peculiarities have a strong impact on the agricultural product markets. One of them is the cereal market with the growing of cereals having the largest share in the crop production in the EU countries (around 70%) [Marcinkowska, Narojczyk, Stępień 2011]. For the purposes of this article, the barley, oats, rye and wheat markets shall be discussed, as these are among the most frequently grown cereals in Poland [Rynek zbóż w Polsce, 2013, p. 2]. The figures presenting Poland's cereal production and prices in comparison with other EU countries shall be shown in charts and tables. Furthermore, the correlation between the prices in selected EU countries shall be presented. The analysis covers the years 2004-2014.

## 2. GLOBAL CONSIDERATIONS IN CEREAL PRODUCTION

On average, global cereal production shows an upward trend. In 2004, it was 2.28 billion tonnes, and, in 2014, 2.82 billion tonnes. The growth rate is around 24%. The production volume is related to soil productivity (crop yield per hectare). And this depends on the technological progress and the related increase in labour productivity [Marciniak 1995]. The analysed period shows significant variations in global cereal production, and they mainly refer to the growth factor. The largest decrease in comparison with the previous year was recorded in 2006 (nearly 1.7%). Instead, the largest increases in global production took place in 2008 (7.66%) and 2013 (8.02%).

**Figure 1. Global cereal production (in billion tonnes) and its growth rate (previous year = 100%) in 2004-2014**

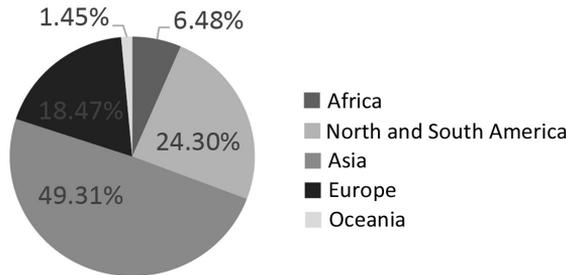


Source: own work based on FAO figures.

In the analysed period, the largest cereal producer was Asia, whose products constituted 49.31% of the global supply. Next were South and North America with a share of 24.3%. Europe was responsible for 18.47% of the global cereal supply. Relatively low shares were attributed to Africa and Oceania (6.48% and 1.45% respectively). This percentage distribution of production was influenced by a variety

of factors. They include favourable climatic conditions (in particular Asia), a high labour input, significant amounts of arable land (the Americas) and relatively substantial importance of capital for agriculture (especially Western Europe and the USA).

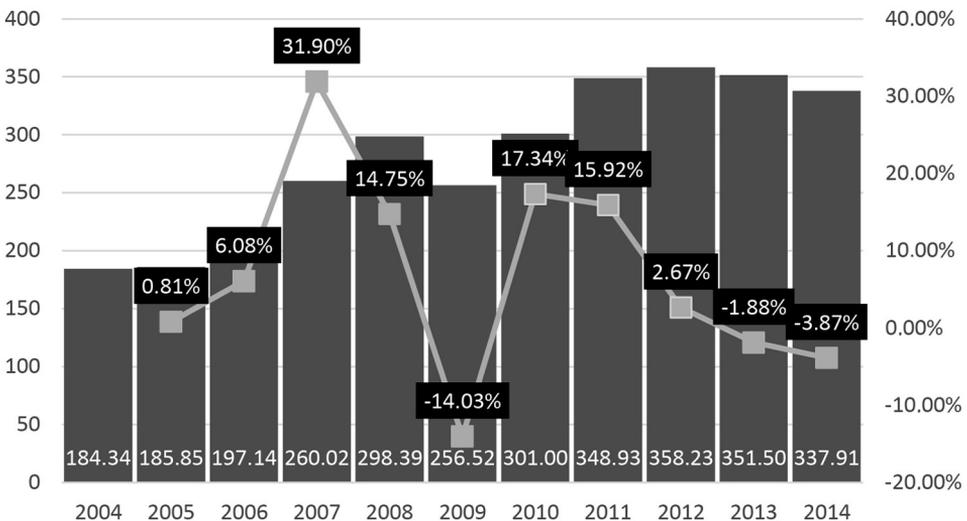
**Figure 2. Average share of individual continents in global production in 2004-2014**



Source: own work based on FAO figures.

As it is difficult to present the average cereal price for the analysed period in one figure, it shall be presented for four cereals produced in the largest quantities (barley, oats, rye and wheat). In 2004-2014, the prices of barley showed an upward trend (from 184.34 USD/t in 2004 to 337.91 USD/t in 2014). However, they fluctuated significantly in certain periods. The largest increase in barley prices was recorded in 2007 (by 31.90% in comparison with the previous year). A significant drop occurred as early as two years later (by 14.03%), and it could be connected with the global economic crisis. The following year was again marked by increasing prices of barley.

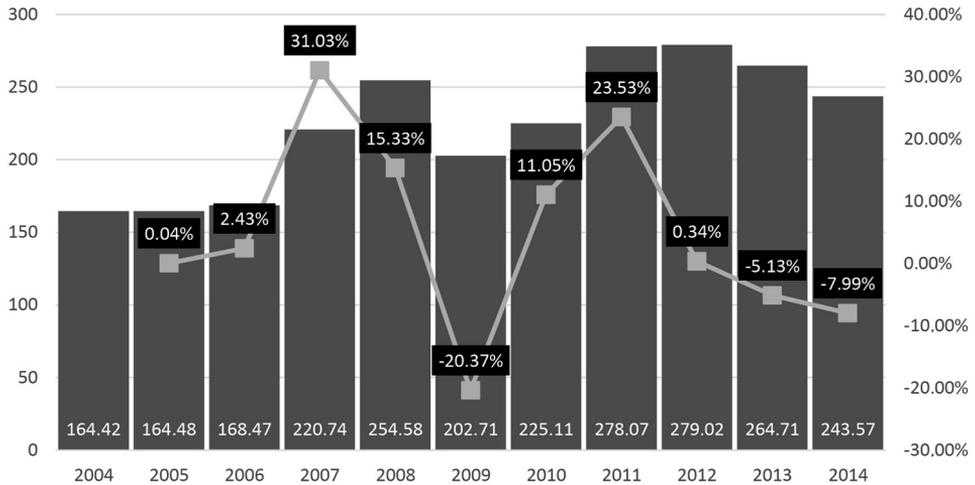
**Figure 3. Global barley prices (in USD/t) and their growth rates (previous year = 100%) in 2004-2014**



Source: own work based on FAO figures.

Similarly to barley, the largest increase in oats prices in comparison with the previous year (by 31.03%) was recorded in 2007, and the largest drop in 2009 (by 20.37%). The prices were between 164.42 USD/t and 279.02 USD/t. The end of the analysed period was marked by a decrease in oats prices, which reached the level of 243.57 USD/t in 2014.

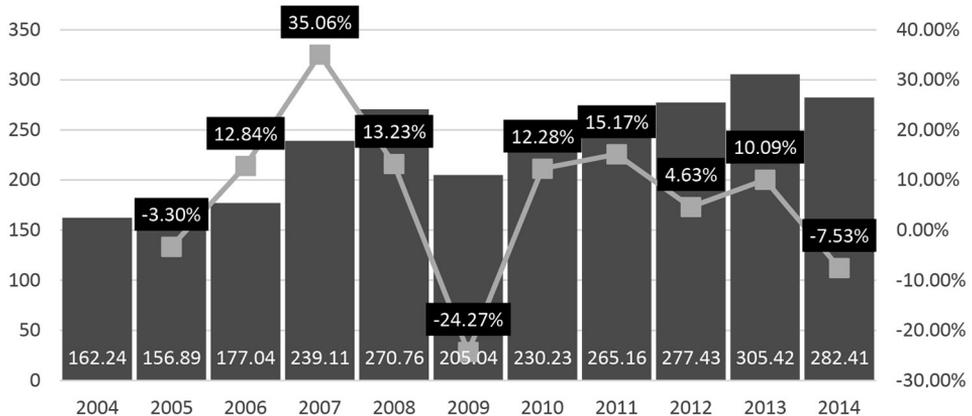
**Figure 4. Global oats prices (in USD/t) and their growth rates (previous year = 100%) in 2004-2014**



Source: own work based on FAO figures.

The prices of rye in the analysed period showed similar trends like in the case of oats and barley. They were between 156.89 USD/t (2005) and 305.42 USD/t

**Figure 5. Global rye prices (in USD/t) and their growth rates (previous year = 100%) in 2004-2014**

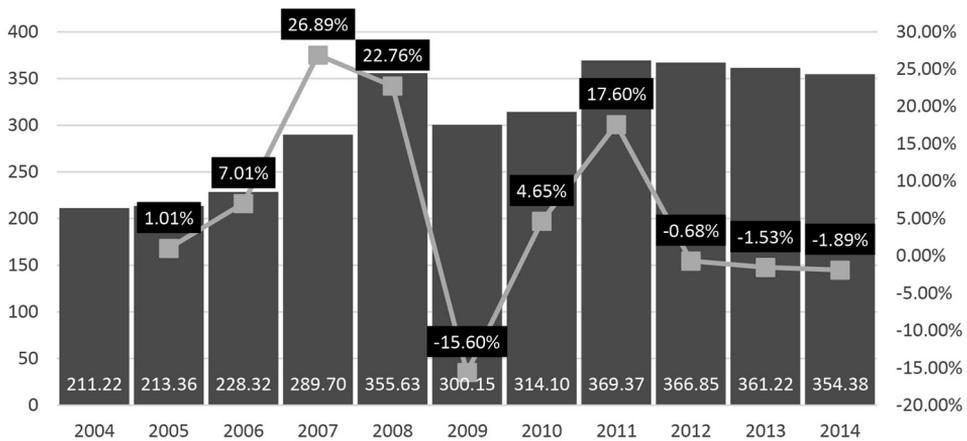


Source: own work based on FAO figures.

(2013). In 2009, the prices began to increase with the exception of the last year covered by the analysis. The changes in the price level were between 35.06% (2007) and -24.27% (2009).

The prices of wheat in 2004-2014 fluctuated between 211.22 USD/t in the first research period to 354.38 USD/t in the last one. The highest increase (similarly to other cereals) was recorded in 2007, followed by a drop two years later. Wheat differs from other cereals analysed because of another significant increase in its prices in 2008 (22.76% in comparison with the previous year). The last three years covered by the analysis were marked by a drop in prices.

**Figure 6. Global wheat prices (in USD/t) and their growth rates (previous year = 100%) in 2004-2014**

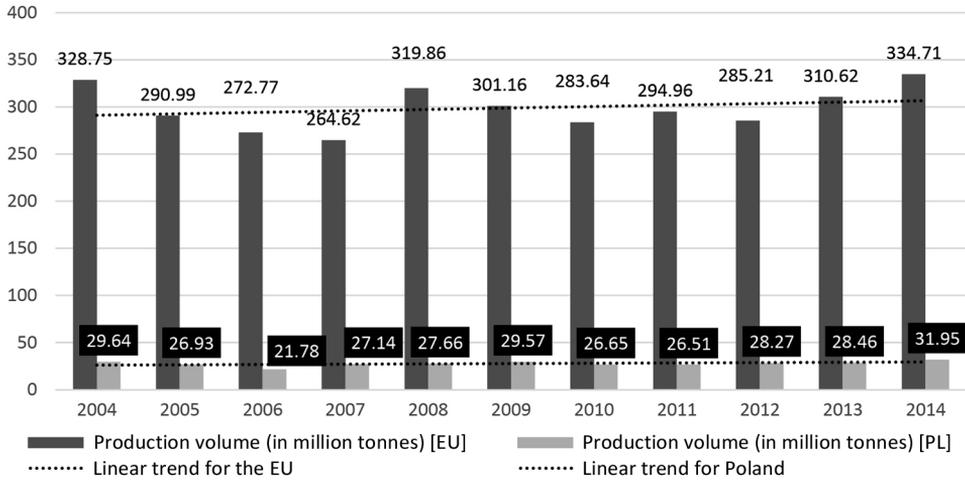


Source: own work based on FAO figures.

### 3. CEREAL PRODUCTION IN POLAND AND THE EUROPEAN UNION

Cereal production in the European Union in 2004-2014 was subject to a variety of changes. Its volume fluctuated between around 265 million tonnes in 2008 and around 335 million tonnes in 2014. It can be ascertained that the decrease in total production in 2004-2007 was reflected in the supply volume of individual cereals. The average volume of Poland’s production was 27.68 million tonnes. The greatest deviations from this value occurred in 2006 and 2014. Both in the case of Poland and the EU in total, an insignificant upward trend was observed as regards cereal production.

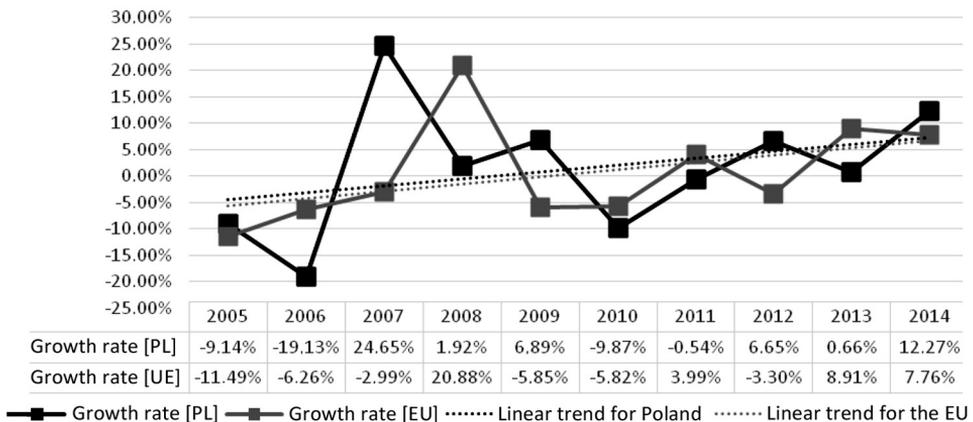
**Figure 7. Comparison of cereal production in the European Union and Poland in 2004-2014 (in million tonnes)**



Source: own work based on FAO figures.

Despite the upward trend regarding the volume of cereal production in the European Union and Poland, production volume decreases were recorded in certain years. The most evident decrease took place in 2005 (in percentage terms, this decrease in cereal production volume in the EU was around 11.5%). Attention should be paid to the year 2008. This is when the highest year-to-year growth rate of production volume was observed (20.88%) in spite of the considerable drops in barley and oats production volumes. As far as Poland is concerned, the highest decrease in comparison with the year before occurred in 2006 and it was

**Figure 8. Comparison of growth rates of cereal production (previous year = 100%) in the European Union and Poland in 2004-2014**

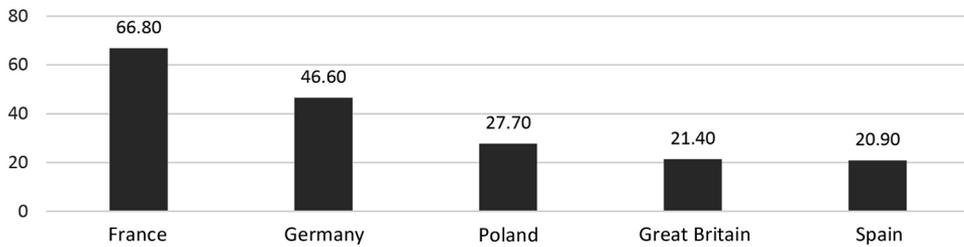


Source: own work based on FAO figures.

around -19%. In turn, the highest growth rate of around 25% was observed as early as a year later. The trends appertaining to Poland and the whole European Union coincided, whereas certain delays (of a year or two) were observed in the process of the markets adjusting to one another.

The largest European cereal producer was France with average production of around 66.8 million tonnes of cereals per year in the analysed period. Second came Germany with its average share in the EU production of around 46.6 million tonnes of cereals per year. Third came Poland with average annual production of 27.7 million tonnes. The next were Great Britain and Spain (the average annual production of these countries was respectively around 21.4 million tonnes and 20.9 million tonnes).

**Figure 9. Average annual amounts of cereals produced by five largest producers in the European Union in 2004-2014 (in million tonnes)**



Source: own work based on FAO figures.

The production capacity of five largest cereal producers was subject to fluctuations. This was connected, among other things, with the climate and rainfall volume in a given year. The annual production capacity increased most often in three periods only, i.e. in 2008, 2012 and 2014. Interestingly enough, the intensity of these increases made it possible, in almost every case, to exceed the production capacity level achieved at the beginning of the period analysed. The said increases in production capacity are likely to have resulted from the need to counteract food crises, and the downward trend could be the consequence of the consumption of cereal surpluses from earlier periods.

When comparing Figure 9 and Table 1, the following conclusions can be drawn:

- France and Germany owed their production volumes both to the substantial production intensity and the large areas of arable land,
- Great Britain is a country with intensive cereal production – the low results in comparison with other largest producers indicate a relatively small area of arable land,
- because of their methods of farming, Poland and Spain were classified as countries with extensive cereal production, whereas the differences in the GDP levels let us ascertain that the first of the above-mentioned cases represents the labour-intensive type and the second one represents the capital-intensive type (mainly along the coast, and not necessarily in central Spain).

**Table 1. Production capacity for all cereals produced by five largest producers (in t/ha)**

Year	France	Germany	Great Britain	Poland	Spain
2004	7.5382	7.3572	7.0305	3.5376	3.7501
2005	6.9813	6.7232	7.1961	3.2331	2.1593
2006	6.8319	6.4866	7.2774	2.5982	3.0282
2007	6.5523	6.1829	6.6334	3.2495	3.9339
2008	7.2883	7.1188	7.4202	3.2172	3.5735
2009	7.4555	7.1994	7.0306	3.4775	2.9488
2010	6.7111	6.7184	6.9530	3.3889	3.2915
2011	6.6213	6.4583	6.9846	3.4343	3.6918
2012	7.2679	6.9649	6.2150	3.7115	2.8425
2013	7.1611	7.3180	6.6296	3.8044	4.0482
2014	7.6343	8.0503	7.6965	4.2680	3.2461

Source: own work based on FAO figures.

The figures presented in the table below indicate that Poland represents extensive cereal production. This was indicated by the relatively low crop yield with the simultaneous maintenance of the crop amount on a significant level.

**Table 2. Comparison of production capacity for all cereals in the EU and Poland (in t/ha)**

Year	European Union	Poland
2004	5.3290	3.5376
2005	4.8357	3.2331
2006	4.6970	2.5982
2007	4.5883	3.2495
2008	5.2314	3.2172
2009	5.0792	3.4775
2010	4.9713	3.3889
2011	5.1319	3.4343
2012	4.9055	3.7115
2013	5.3409	3.8044
2014	5.7341	4.2680

Comparison of production capacity for all cereals in the EU and Poland (in t/ha).

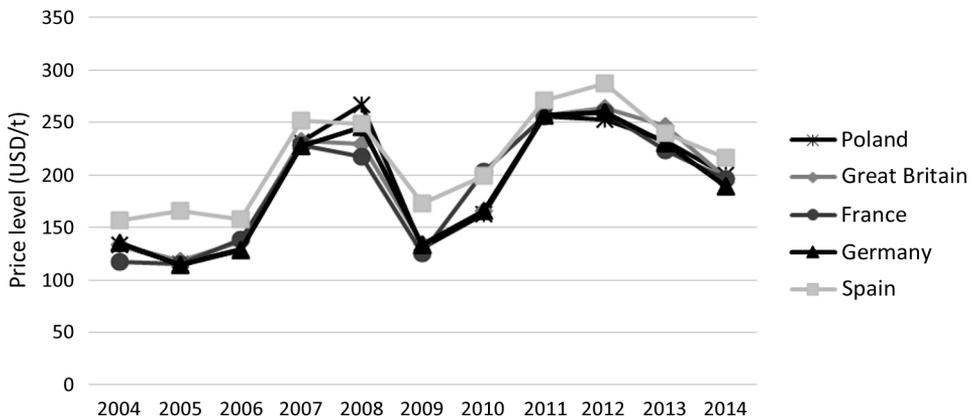
Source: own work based on FAO figures.

The next part shall discuss the prices of the main cereal species (barley, oats, rye and wheat) in Poland in comparison with other EU countries in 2004-2014. To provide the wider picture of the situation, the aggregate cereal market both in Poland and the whole EU shall be also briefly analysed. Furthermore, five largest producers in the European Union shall be specified for each cereal.

### 3. CEREAL PRICES IN POLAND AND THE EUROPEAN UNION

At the beginning of the analysed period, the prices of barley in the top five barley producing countries fluctuated between USD 118 per tonne in France and USD 156 per tonne in Spain. In 2005, they were relatively stable, although there was a decrease in the prices of this cereal in Poland and Germany. The years 2006-2008 were marked by a sharp increase in the price level experienced by all the five largest global producers (the prices approached the level of USD 250-300 per tonne, with the exception of France). Moreover, this was when significant differences in the price level clarified – the price of barley in Poland was around USD 267 per tonne, and in France it was around USD 218 per tonne. In 2009-2011, the prices of barley increased substantially again (USD 250-270 per tonne). In 2012, slight increases in the global prices of barley were observed, and the last two years covered by the analysis were marked by their substantial drop. The prices of barley in Poland were among the lowest (except for the year 2008, when Poland's prices were the highest in comparison with five largest producers in the EU and amounted to USD 267.3 per tonne). The prices of barley in Poland converged with the prices of other largest producers.

**Figure 10. Barley prices (in USD per tonne) in the top five barley producing countries in the European Union in 2004-2014**

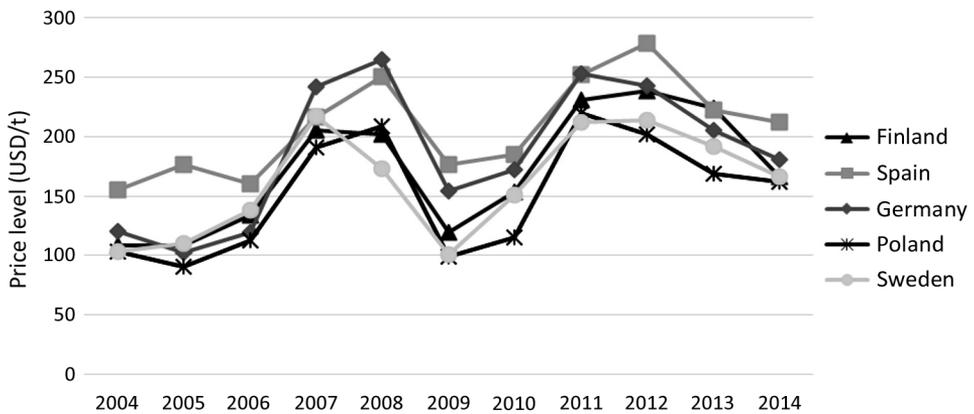


Source: own work based on FAO figures.

At the beginning of the analysed period, the prices of oats in the top five oats producing countries fluctuated between USD 103 per tonne in Poland and USD 155 per tonne in Spain. The year 2005 was marked both by decreases in oats prices in Germany and Poland, and increases in the prices of this cereal in Spain and Sweden. In 2005-2008, there was a substantial increase in the prices in the top five oats producing countries in Europe, with the exception of Sweden (in 2008, the prices fluctuated between USD 173 per tonne and USD 265 per

tonne). In the following year, the prices of oats dropped rapidly. By contrast, in 2010-2012, the prices increased substantially again. This was extremely evident in the case of Spain, where the prices of oats reached the record level of USD 279 per tonne in 2012. The analysis of the following chart indicates that the prices of oats in Poland were among the lowest ones in the European Union. They were subject to trends that were similar to those pertaining to other largest producers, although a large amplitude of their changes was observed, especially in 2008-2011.

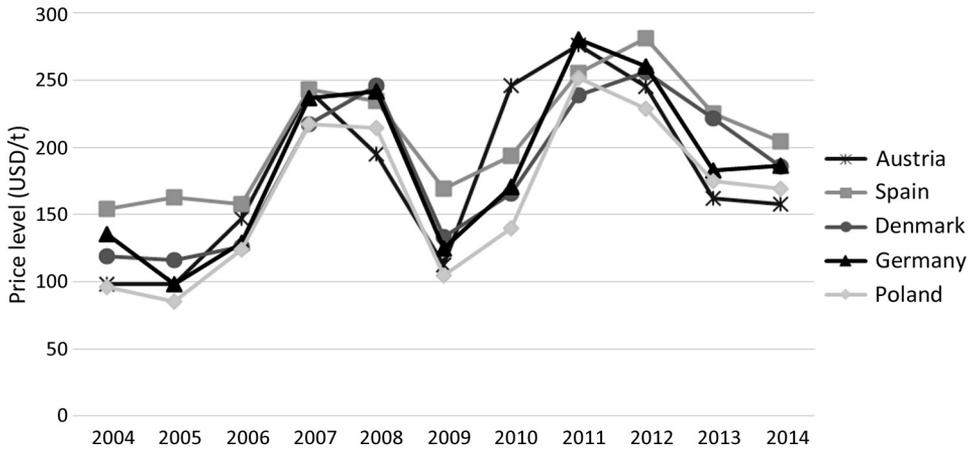
**Figure 11. Oats prices (in USD per tonne) in the top five oats producing countries in the European Union in 2004-2014**



Source: own work based on FAO figures.

At the beginning of the analysed period, the prices of rye in the top five rye producing countries fluctuated between around USD 96 per tonne in Poland and USD 154 per tonne in Spain. The year 2005 was associated with decreasing rye prices of the largest producers of this cereal (except for Austria and Spain). The following two years were marked by significant increases in the prices in the said countries – the average rye prices were USD 220 per tonne at that time. In 2007-2009, the prices decreased, especially in Austria and Poland. The prices of rye increased again in 2009-2011. Attention should be paid to the fact that it was in 2011 that the average rye prices of the largest producers were the highest with their average level of around USD 260. In the following years, the prices dropped, with the record level of rye prices in Spain in 2012. Similarly to oats, the prices in Poland were among the lowest in Europe. For a considerable part of the analysed period, the rye rates in Poland were the lowest in comparison with other largest producers. This was except for 2008 and 2013, when the Austrian prices per tonne were lower than in Poland, and 2011, when the Danish prices per tonne of rye were lower than the Polish ones).

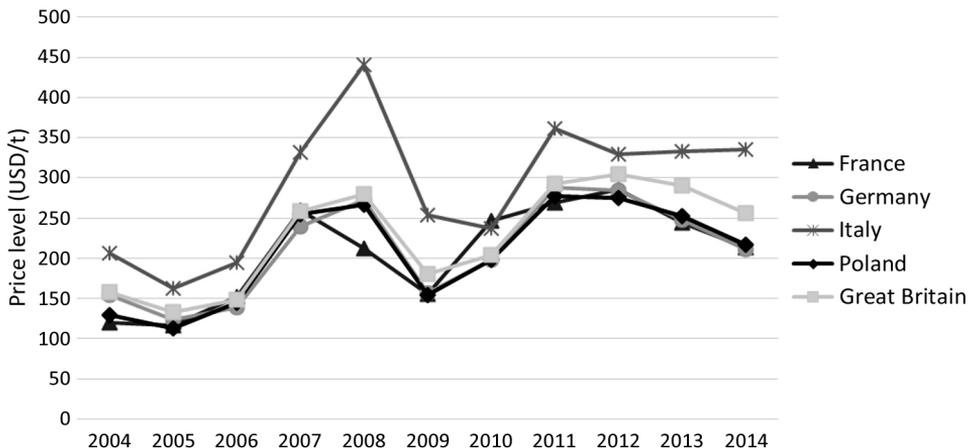
**Figure 12. Rye prices (in USD per tonne) in the top five rye producing countries in the European Union in 2004-2014**



Source: own work based on FAO figures.

At the beginning of the analysed period, the prices of wheat in the top five wheat producing countries fluctuated between around USD 120 per tonne and USD 206 per tonne. In 2005, the prices dropped by around USD 25 per tonne. In 2005-2008, there was a significant increase in the prices, which was particularly evident in the case of Italy, where wheat cost more than USD 440 per tonne. As early as a year later, the prices decreased substantially, by over 50%. In 2010-2011, the prices again reached relatively high levels. The last three years analysed were marked for the most part by price decreases, except for Italy, where the prices were relatively stable and were more than USD 330 per tonne of wheat.

**Figure 13. Wheat prices (in USD per tonne) in the top five wheat producing countries in the European Union in 2004-2014**



Source: own work based on FAO figures.

Again, the prices of wheat in Poland were among the lowest. Moreover, they were characterised by the greatest convergence with the prices in Germany and also, although to a lesser extent, with the prices in France. The British prices were comparable to the Polish ones. The Italian prices, on the other hand, stood out among the other producers due to the intensity of their changes, although it should be noticed that they were subject to processes similar to those characteristic of other producers.

In order to assess the convergence of the prices on the cereal market in Poland with the prices in other top barley, oats, rye and wheat producing countries in the EU, the correlation coefficients shall be estimated. The following correlation matrices show very strong price convergence for the cereals analysed in individual countries. Good examples are the pairs of countries being the largest producers, which have the correlation exceeding 95% for all the cereals analysed: Poland and Germany, Poland and Great Britain, Great Britain and Germany, Great Britain and Spain, France and Spain, Sweden and Finland, Denmark and Spain, and Denmark and Poland.

**Table 3. Correlation matrix for barley prices in the top five barley producing countries in the EU**

Country	Poland	Great Britain	France	Germany	Spain
Poland	1	0.973534	0.93173	0.9916	0.958946
Great Britain	0.973534	1	0.960531	0.989664	0.976409
France	0.93173	0.960531	1	0.954607	0.963983
Germany	0.9916	0.989664	0.954607	1	0.979592
Spain	0.958946	0.976409	0.963983	0.979592	1

Source: own work.

**Table 4. Correlation matrix for oats prices in the top five oats producing countries in the EU**

Country	Finland	Spain	Germany	Poland	Sweden
Finland	1	0.918342	0.913141	0.936002	0.956957
Spain	0.918342	1	0.904436	0.922927	0.842777
Germany	0.913141	0.904436	1	0.954105	0.868374
Poland	0.936002	0.922927	0.954105	1	0.912677
Sweden	0.956957	0.842777	0.868374	0.912677	1

Source: own work.

**Table 5. Correlation matrix for rye prices in the top five rye producing countries in the EU**

Country	Austria	Spain	Denmark	Germany	Poland
Austria	1	0.819835	0.774126	0.864866	0.853024
Spain	0.819835	1	0.969649	0.944578	0.95001
Denmark	0.774126	0.969649	1	0.943168	0.956315
Germany	0.864866	0.944578	0.943168	1	0.985351
<b>Poland</b>	<b>0.853024</b>	<b>0.95001</b>	<b>0.956315</b>	<b>0.985351</b>	<b>1</b>

Source: own work.

**Table 6. Correlation matrix for wheat prices in the top five wheat producing countries in the EU**

Country	France	Germany	Italy	Poland	Great Britain
France	1	0.89282	0.703225	0.926684	0.890781
Germany	0.89282	1	0.898966	0.984908	0.974344
Italy	0.703225	0.898966	1	0.904635	0.902984
Poland	0.926684	0.984908	0.904635	1	0.978551
<b>Great Britain</b>	<b>0.890781</b>	<b>0.974344</b>	<b>0.902984</b>	<b>0.978551</b>	<b>1</b>

Source: own work.

### 3. SUMMARY

The authors of this study have aimed to provide a comparative analysis of the Polish and EU cereal markets in 2004-2014. The criteria used for this research were the production volume and the price level in the major cereal producing countries in the EU. Because of the insufficient amount of data concerning demand in the European Union, this aspect has not been taken into account. In order to define Europe's importance on the global cereal market, the production volume and prices have been analysed in continental terms. The above-mentioned analysis is followed by a presentation of the EU market situation with particular attention being paid to Poland from the viewpoint of production volume, production dynamics and production capacity in the top five cereal producing countries. The last issue discussed in the article involves the prices of the cereal species described in the study.

The main conclusions of the research conducted shall be as follows:

- the largest cereal producers in the European Union are France, Germany, Poland, Great Britain and Spain;
- Moreover, Poland is among the five largest producers of each of the cereals discussed in the article (5-7% of the EU production value), and it is responsible for a significant part of the rye market;
- wheat is the most frequently grown cereal from among the discussed species. It constitutes half of EU crops and one third of Poland's crops;
- the prices in individual cereal markets converge;
- a downward trend refers to the production of barley both in Poland and the EU, oats in the EU and rye in Poland.

An upward trend refers to the production of oats in Poland, rye in the EU and wheat both in Poland and the EU.

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## POZYCJA POLSKI JAKO PRODUCENTA ZBÓŻ NA TLE PAŃSTW UNII EUROPEJSKIEJ

**Streszczenie:** Celem artykułu jest porównanie polskiego rynku zbóż z rynkiem unijnym, bazując na produkcji najbardziej popularnych zbóż: jęczmienia, owsa, żyta i pszenicy. W artykule przedstawiono Polskę jako jednego z największych producentów na tle wybranych państw Unii Europejskiej w latach 2004-2014. Wybór pozostałych państw uzależniony był od wielkości rynku zbóż. Przedstawiono także korelacje pomiędzy cenami zbóż. Okres badania dotyczy wielu zmian w rolnictwie związanych z wejściem do Wspólnoty, przystosowania do standardów oraz pierwszej dekady ich funkcjonowania. Polska jest jednym z największych producentów zbóż wybranych do analizy w Unii Europejskiej. Natomiast ich ceny w poszczególnych państwach charakteryzują się wysoką korelacją.

**Słowa kluczowe:** rynek zbóż, Unia Europejska, zboża, Polska.

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