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**Cereal Market before
and after the Integration
of Poland into
the European Union.
Dynamics of Supply
and Demand Correlations**

1. Introduction

Cereal production comprises a strategic branch of agriculture in Poland as well as in other European Union member countries in which an average area under crop covers about 70% of total arable area. In Poland this indicator is higher and it amounts to ca. 75%. Apart from that, an arable area per capita in Poland is much above a European average. Thanks to that, land can be used less intensely, allowing for the application of ecological crops (Czyżewski, Henisz-Matuszczak 2006, p.31-32). Apart from centuries-long tradition, a relatively easy technology of cereal growing, storing and trade as well as the possibility of using cereals just on the same farm for animal fodders have an influence on cereal production in Poland.

An agricultural sector in Poland found itself in quite new circumstances on the day of 1 May 2004 when Poland joined the community of the European Union member countries (Zegar 2010, p.23). This integration into the Community would not be possible without long-lasting system transformation which for

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fifteen years had been recreating the principles of market economy and brought it closer to the EU structures and standards (Urban, Szczepaniak, Mroczek 2010, p.76.) Apart from that, agriculture, just like other branches of national economy, depends on domestic and international macroeconomic conditions, as a result of which the agricultural sector is changing under the influence of globalization processes, among others (Kucharski 2011, p.223-224). This article, thanks to comparing the formation of supply-demand correlations before and after the integration into the EU, will allow us to identify the changes which occurred on the Polish cereal market during the studied period.

2. Purpose and research method

The purpose of this publication is to identify the formation of the supply-demand relationship and the level of market prices of cereals in the period before and after the accession to the European Union. The time range covers the period 1995-2012. Analyzing long period is important because of the greater accuracy of the study. In addition, the time interval is chosen so that there was comparable number of periods both before and after the Polish accession to the EU. Used in this work statistics are from the Institute of Agricultural and Food Economics. To achieve this article objective were used the following statistical methods: a dynamic index - were used to assess the evolution of the phenomena in question at the time, while the surveys for the correlation between the variables and to determine their strength, direction and significance were performed using correlation and regression analysis .

3. Cereal production in Poland in the years 1995-2012

The structure of harvested crops and crop yields, which are determined by climate conditions, quality and structure of soils and level of farming culture, is of a strategic importance for the cereal market. Owing to their geographical position, Polish farmlands are mostly covered by winter crops, whose harvest is much higher than in case of spring crops. Only barley cultivation is an exception. As a result of weak freezing tolerance, there prevail spring specimens. An average cereal production volume in Poland in the years 1995-2003 amounted to 25 402 thousand tons, whereas in the years 2004-2012 this figure went up to 27 025 thousand tons.

The most commonly produced cereal in Poland was wheat whose share in the structure of harvested crops was the highest of all (fig. 1). In the pre-integration

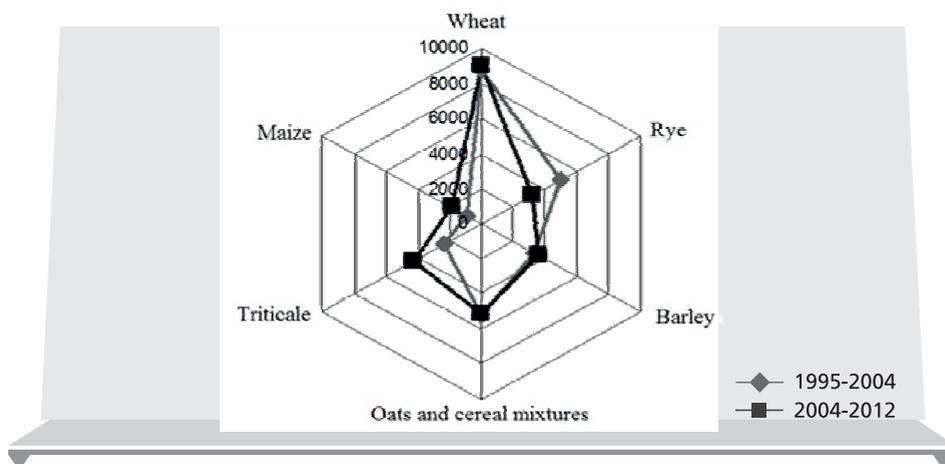


Figure 1. Dynamics of cereal production in Poland in the years 1995-2012. An arithmetic average for the period before and after the integration of Poland into the EU [thousand tons]

Source: author's own data compilation based on: *Market Analyses. Cereal market – condition and prospects*, No. 20 - 43, IERiGŻ, Warsaw 2001-2012

period an average wheat production volume was 8 776 thousand tons (35% of total cereal production), while after the integration this figure increased to 8 982 thousand tons (33%). Oats and cereal mixtures achieved the second highest production volume (1995-2003: 5 211 thousand tons – 21% of market share, 2004-2012: 5 121 thousand tons – 19 %). Therefore, it can be claimed that production of these two kinds of cereals was at a similar level in both studied period. Likewise, barley production maintained a similar level of production structure share (13% - for 3 323 thousand tons and 3 581 thousand tons respectively before and after the EU accession). Interesting changes took place in case of other cereal species. The first change was a decrease in average rye production volume in the studied periods (from 4 884 thousand tons – 19% to 3 256 thousand tons – 12%). The second one was an increase in average annual triticale production volume (from 2 293 thousand tons – 9% in the years 1995-2003 to 4 184 thousand tons – 15% for the period between the year 2004 and 2012) and maize volume (from 915 thousand tons – 4% to 1 901 thousand tons – 7%).

When analyzing a supply rate on the cereal market, one should also consider the data concerning area under crop and crop yields (table 1). On account

Table 1. Cereal production volume [thousand tons], cropped area [million ha] and volume of crop yields [t/ha] in Poland in the years 1995-2012. Absolute change compared to the previous year, starting from the base year

Item	1995 /96	1996 /97	1997 /98	1998 /99	1999 /00	2000 /01	2001 /02	2002 /03	2003 /04	2004 /05	2005 /06	2006 /07	2007 /08	2008 /09	2009 /10	2010 /11	2011 /12
Production	25859	-612	103	1751	-1411	-3423	4635	-64	-3491	6214	-2715	-5132	5326	542	2145	-2643	-437
														27 025**			
Area under crop	8 532	147	178	-57	-147	99	13	-507	-132	200	-70	38	-24	256	-23	-982	189
														8 176**			
Crop yields	3,03	-0,12	-0,05	0,22	-0,11	-0,43	0,53	0,18	-0,38	0,68	-0,30	-0,63	0,65	-0,04	0,27	0,10	-0,14
														3,31**			

*An arithmetic average for the years 1995-2004, **An arithmetic average for the years 2004-2012

Source: Author's own data compilation based on:
Market Analyses. Cereal market – condition and prospects, No. 20 - 43, IERIGŻ, Warsaw 2001-2012

of an even distribution of years before and after the integration of Poland into the European Union, just like in case of evaluating the formation of the harvested crop structure, one can compare changes of particular volume figures, by means of an average arithmetic. In the entire studied period, production volume amounted to 26 165 thousand tons on average. However, in the years 2003-2012 this volume went up by 6.4% when compared to the years 1995-2003. Annual changes in cereal production for all the years, when observation was conducted, were mainly the result of different crop yields. In the seasons characteristic of weak crop yields, production volume drastically dropped and vice versa. An average value of crop yields before the integration amounted to 2.95 t/ha and was lower by 12.08% than in the period after the integration (3.31 t/ha). An average volume of crop yields in the years 1995-2012 was 3.12 t/ha. The size of area under crop was quite stable in the studied period with a slightly falling tendency. An average area under crop reduced by about 4.96%, from 8 602 million ha (1995-2003) to 8 176 million ha (2004-2012). It was 8 402 million ha in the entire studied period on average (Józwiak, Michna, Mirkowska 2011, p.12-13).

Cereal foreign trade in Poland in the studied period underwent important transformations (fig. 2). From mid 1990s we experienced a very unfavourable situation because every single year had a negative balance of trade exchange.

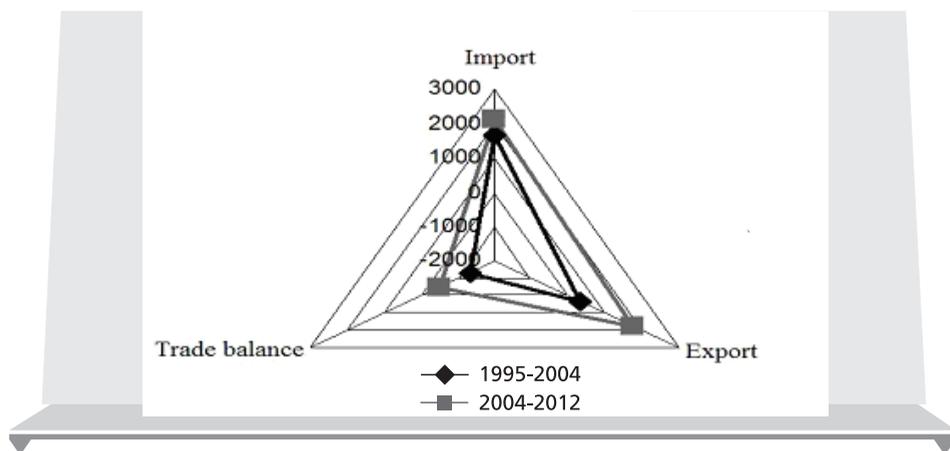


Figure 2. Poland's foreign trade on the cereal market in the years 1995-2012. An arithmetic average for the period before and after the accession of Poland into the EU [thousand tons]

Source: author's own data compilation based on: *Market Analyses. Cereal market – condition and prospects*, No. 20 - 43, IERiGŻ, Warsaw 2001-2012

The worst period in this regard was the 1996/1997 season. Export volume amounted to 224 thousand tons then, whereas import was at the level of 3 427 thousand tons, what contributed to a negative trade balance of 3 203 thousand tons. This disproportion began to decrease in the previous decade though and already in the 2002/03 season, the trade balance of Poland was positive and amounted to 389 thousand tons. Despite the fact that there was still a trade disproportion with prevailing import, there were some beneficial changes in relation to the beginning of the studied period (Kowalski 2009, p.30). The said transformations can be also confirmed by changes of average values. In the years 1995-2004 annual average export amounted to 332 thousand tons, whereas import was 1 636 thousand tons, what gave the trade exchange balance of 1 304 thousand tons. But in the years 2004-2012, export went up to 1 781 thousand tons while import to 2 128. An average trade balance in such circumstances amounted to 347 thousand tons so it was nearly 1 million tons more profitable than before the integration into the UE.

The above data reveal that despite substantial cropped areas, Polish farmers did not produce as many cereals as they were able to, mostly due to low efficiency expressed in crop yields per hectare (Poczta, Czubak, Pawlak 2009, p.48). Although first symptoms of improvement in this respect were already observed, for example, the data before and after the integration, the figures still differ from a European average. As the years went by, the sown crops structure also changed as rye was becoming less popular while triticale and maize production increased instead. Currently, trade exchange balance on the cereal market has come closer to a balance level. This may result, among others, from a comparative advantage in relation to other EU member countries in the form of lower manufacturing costs, thanks to cheaper manpower and high quality of Polish products (Pawlak, Kołodziejczak M., Kołodziejczak W. 2010, p.140). Moreover, among the most important determinants of development of production of cereals in Poland in recent years should be subject to the regulations emphasize the Common Agricultural Policy. In practice, this meant taking the cereals market intervention mechanisms used on a large scale in the EU, among others system of intervention stocks a wide range of subsidies, protectionism in trade with countries outside the EU.

4. Demand on the cereal market in Poland in the years 1995-2012

Indispensable as it seems to be in the analysis of supply formation on agricultural markets is the relationship of supply and demand. The final demand

Table 2. Cereal demand in Poland in the years 1995-2012 [thousand tons]. Absolute change compared to the previous year, starting from the base year

Item	1995 /96	1996 /97	1997 /98	1998 /99	1999 /00	2000 /01	2001 /02	2002 /03	2003 /04	2004 /05	2005 /06	2006 /07	2007 /08	2008 /09	2009 /10	2010 /11	2011 /12
Domestic consumption	27263	-1260	997	979	-360	-2465	1308	1083	-1264	-362	813	384	-307	-605	1189	842	-460
					26812*									27023**			
Consumption	5815	0	-5	-20	-1	4	0	-1	-40	2	-150	-270	-74	-60	-15	-30	-38
					5794*									5326**			
Sown crops	1919	71	-20	-23	0	-15	-128	-47	-8	30	-71	11	26	16	-2	-38	21
					1891*									1742**			
Industrial use	1083	-401	94	48	135	-28	261	319	60	-70	274	195	30	130	770	35	-45
					1059*									2263**			
Grazing	17277	-1215	903	1069	-411	-2219	867	1107	-1165	-583	795	610	-345	-740	320	928	-368
					16803*									16504**			
Losses and wastes	1169	291	19	-95	-79	-212	310	-295	-111	258	-35	-162	56	49	116	-53	-29
					1266*									1189**			

*Arithmetic average for the years 1995 - 2004. ** Arithmetic average for the years 2004 - 2012

Source: Author's own data compilation based on:
Market Analyses. Cereal market – condition and prospects, No. 20 - 43, IERIGZ, Warsaw 2001-2012

for cereals can be divided into several smaller ones, reported by various groups of clients. The biggest quantities of cereals are delivered to animal breeders for grazing purposes (mostly swine and cattle). A considerable percentage of production is also destined for consumption. However, lower quantities of cereals are destined for next sown crops as well as for industrial purposes (malt in breweries, spirit in distilleries, grain coffee in concentrate plants, among others). The remaining part of cereal production is under the item of losses and wastes.

The domestic consumption of cereals in the years 1995–2003 was 26 812 thousand tons on average and was lower by as little as 0.79% than average consumption in the years 2004 – 2012, amounting to 27 023 thousand tons (table 2). This proved considerable stabilization on the market of clients reporting an almost identical demand during seventeen years. This aggregated value consists of consumer's consumption, among others. Before the integration it was ca. 5 794 thousand tons annually in relation to 5 326 thousand tons after the accession. A considerable drop in this value is noticeable especially in the years 2005 – 2006, when the wave of Poles' wage-earning emigration took place. This phenomenon affected a smaller demand for cereals from which basic foods like bread, groats and cereal are produced. During the analyzed period the use of cereals for next sown crops purposes also decreased, what was caused by reduced cropped areas, among others. In the pre-integration period 1 891 thousand tons was spent for this purpose on an average annual basis whereas in the years 2004 – 2012 this value decreased by 8.08% to the level of 1 742 thousand tons. In case of the use of industrial crops, we could observe a significant growth of an average demand for crops in the studied periods, that is by as much as 113.7% (from 1 059 thousand tons to 2 263 thousand tons). The volume of crops destined for animal breeding did not change considerably as an average number for the years 1995-2003 was 16 803 thousand tons whereas in the years 2004 - 2012 was at the level of 16 504 thousand tons. In the same periods the total loses and wastes dropped slightly from 1 266 thousand tons to 1 189 thousand tons. The above data prove bigger stability of supply and demand correlations on the cereal market in Poland in the years 1995 – 2012. This allowed to improve trade exchange balance just due to growing production and a similar domestic demand rate, among others. Another significant phenomenon was a considerable increase in use of industrial crops. This may indicate a growing demand of the society for highly processed goods, the major ingredient of which are cereals.

5. Price formation before and after the integration of Poland into the European Union

Cereal purchase prices comprise a completion of the supply-demand correlations analysis on the cereal market. Therefore, one should follow the formation of wheat and rye purchase prices in the studied period (fig. 3).

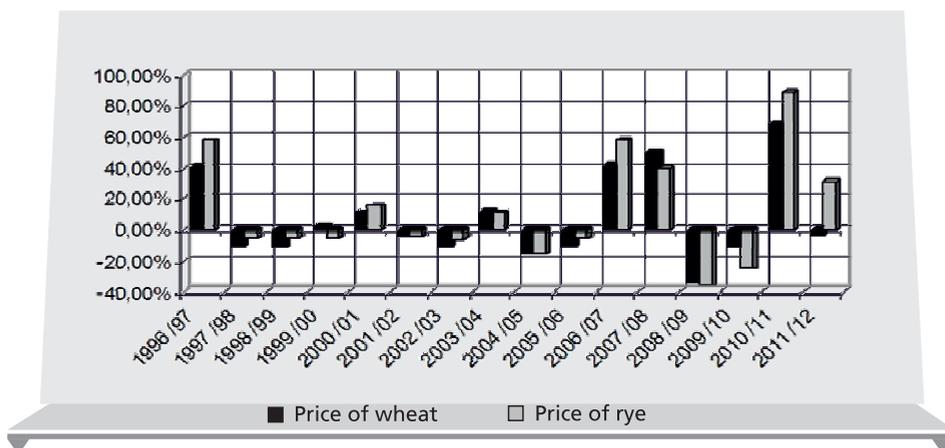


Figure 3. Wheat and rye price dynamics in Poland in relation to the previous year in the years 1995 - 2012 [%]

Source: author's own data compilation based on: *Market Analyses. Cereal market – condition and prospects*, No. 20 - 43, IERiGŻ, Warsaw 2001-2012

In Poland an annual average price of one ton of wheat in the years 1995- 2003 was 447 PLN / ton, whereas in the years 2004- 2012 this price grew by 22.01%, to the amount of 582 PLN / ton. Interesting as it seems to be is the fact that the highest price of wheat was recorded in 2010/11, when it amounted to 795.2 PLN / ton. Just to compare, in the same period the price of intervention purchase conducted by the Agricultural Market Agency was 101.31 EUR / ton. An annual average price of rye before the integration amounted to 338 PLN / ton, whereas after the integration it was 475 PLN / ton (growth by 40.42%). A record-breaking price of this cereal, just like in case of wheat, occurred in the 2010 / 11 season, when it amounted to 588.2 PLN / ton. When following year-to-year price dynamics it can be observed that ton rates grew by about 40-50% per year in the years 2006 and 2007 on wheat market (Stańko 2008, p. 417), then they dropped

in two subsequent seasons by ca. 35% and 10% respectively. In 2010 / 2011 wheat prices rose by as much as over 60%. Rye price dynamics fluctuated in a similar way, like in case of wheat. Rye price in the 2010 / 11 season grew by ca. 90%. In general, one can claim that in the period before the integration into the EU, there had not been such rapid price fluctuations on the cereal market as during the seasons after the integration (Seremak-Bulge 2009, p. 128-129).

These fluctuations in the market price of cereals in recent years have shown the ineffectiveness of a wide variety of mechanisms, the intervention of the CAP, which had a greater extent determine prices and farmers' incomes. This is mainly due to the situation on the world markets. Similar processes occur also in other agricultural markets, which are becoming increasingly dependent on international economic conditions and changing under the influence of globalization. Inevitably, this translates to an increase in international trade and opening up and integration of economies.

6. Correlation between production volume and prices, consumption and demand

On the framework of the all above considerations there was undertaken an effort of identifying an influence of selected variables which characterize cereal market in Poland on the volume of their production in two periods: before and after the integration of Poland into the EU (tab. 3).

Table 3. Values of correlation coefficients related to selected variables connected with cereal production in Poland in the years 1995 - 2004 and 2004-2012 (significant correlations: $-0.5 \leq r \leq 0.5$ for $p = 0.05$)

	Production	Area under crop	Crop yields	Domestic consumption	Consumption	Sown crops	Industrial use	Price of wheat	Price of rye	Trade balance
1995-2004										
Production	1,00	0,17	0,90	0,78	0,33	-0,04	-0,04	-0,44	-0,37	0,49
Area under crop	0,17	1,00	-0,28	-0,04	0,61	0,77	-0,87	0,28	0,10	-0,39
Crop yields	0,90	-0,28	1,00	0,78	0,06	-0,38	0,35	-0,55	-0,41	0,66
Domestic consumption	0,78	-0,04	0,78	1,00	0,07	0,00	0,06	-0,70	-0,54	0,63
Consumption	0,33	0,61	0,06	0,07	1,00	0,67	-0,68	0,06	-0,34	-0,42

Sown crops	-0,04	0,77	-0,38	0,00	0,67	1,00	-0,97	0,28	-0,06	-0,67
Industrial use	-0,04	-0,87	0,35	0,06	-0,68	-0,97	1,00	-0,40	-0,10	0,66
Price of wheat	-0,44	0,28	-0,55	-0,70	0,06	0,28	-0,40	1,00	0,85	-0,62
Price of rye	-0,37	0,10	-0,41	-0,54	-0,34	-0,06	-0,10	0,85	1,00	-0,18
Trade balance	0,49	-0,39	0,66	0,63	-0,42	-0,67	0,66	-0,62	-0,18	1,00
2004-2012										
Production	1,00	0,15	0,87	-0,22	0,15	0,66	0,12	-0,15	-0,29	0,82
Area under crop	0,15	1,00	-0,35	-0,76	0,34	0,42	-0,54	-0,70	-0,69	0,12
Crop yields	0,87	-0,35	1,00	0,17	-0,03	0,42	0,39	0,21	0,06	0,72
Domestic consumption	-0,22	-0,76	0,17	1,00	-0,68	-0,52	0,86	0,63	0,56	-0,12
Consumption	0,15	0,34	-0,03	-0,68	1,00	0,12	-0,84	-0,70	-0,64	0,19
Sown crops	0,66	0,42	0,42	-0,52	0,12	1,00	-0,12	-0,15	-0,18	0,23
Industrial use	0,12	-0,54	0,39	0,86	-0,84	-0,12	1,00	0,57	0,48	0,14
Price of wheat	-0,15	-0,70	0,21	0,63	-0,70	-0,15	0,57	1,00	0,93	-0,38
Price of rye	-0,29	-0,69	0,06	0,56	-0,64	-0,18	0,48	0,93	1,00	-0,48
Trade balance	0,82	0,12	0,72	-0,12	0,19	0,23	0,14	-0,38	-0,48	1,00

Source: author's own data compilation based on: *Market Analyses. Cereal market – condition and prospects*, No. 20 - 43, IERiGŻ, Warsaw 2001-2012

An initial correlation analysis revealed that the strongest production level determinant in both cases are crop yields. A correlation coefficient for these two variables amounted respectively 0.9 before and 0.87 after the integration. Among other interesting and pretty obvious correlations, it is worth pointing out a positive correlation between cropped area and sown crops, which was stronger in the years 1995 – 2004, and crop yields and production volumes with trade balance. During the pre-integration period there was a significant positive correlation between production and domestic consumption which disappeared after 2004. Likewise, the correlation between domestic consumption and prices of wheat and rye turned from negative in the years 1995–2004 to positive after the

accession to the EU. However, in both periods there occurred a strong negative correlation between consumer's consumption and industrial use.

The generated function of regression for the years 1995 - 2012 (fig. 4) confirms a strong correlation between cereal production volume and cereal yields. A correlation coefficient for these two variables amounted to 0.88 and $R^2 = 76.57\%$.

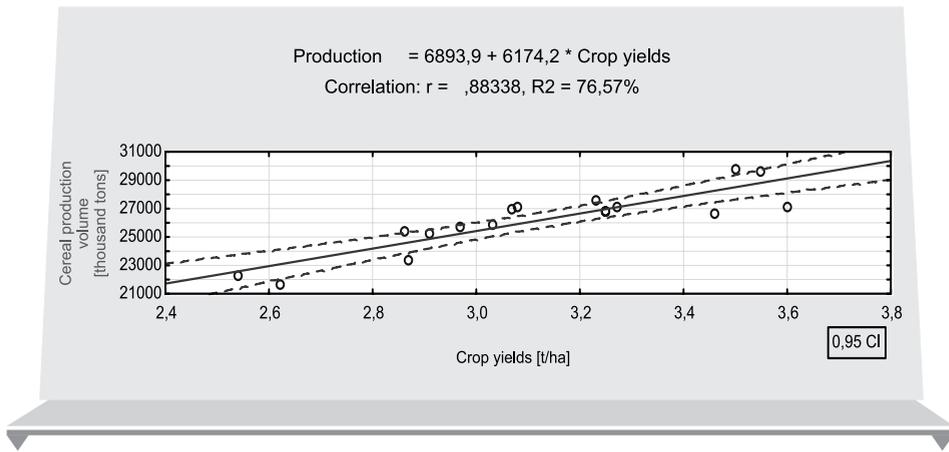


Figure 4. Regression function showing an influence of yielding on production volume in Poland in the years 1995 -2012

Source: author's own data compilation based on: *Market Analyses. Cereal market – condition and prospects*, No. 20 - 43, IERiGŻ, Warsaw 2001-2012

7. Summary

A fundamental intention of the above article was to identify the effects of the integration of Poland into the European Union, noticeable in the functioning of domestic cereal market. The analysis was made in terms of supply, demand and prices in the years 1995 - 2012. When summarizing the results of the study it can be claimed that:

1. The structure of cereal harvest in Poland changed after the integration of Poland into the European Union. Triticale and maize production significantly increased whereas rye crop decreased. Besides, an average area of sown crops decreased whereas crop yields per hectare increased in relation to the EU pre-accession period. Increased crop yields seemed to be higher within these two

phenomena, therefore total cereal production volume in Poland also grew during an analogous period;

2. Cereal trade balance in Poland considerably improved after the year 2004. During previous years, Poland's export volume was insignificant, especially in comparison with the scale of import. Such a situation occurred mostly in the second half of the 1990s. In the 2004 – 2012 period, though, the volume of exported and imported products was at a similar level;
3. A rapid drop of cereal consumption in Poland was observed soon after the integration into the European Union. Apart from that, a considerable growth of an average use of industrial crops (by as much as 113%) in the years 2004 – 2012 had a symptomatic meaning. This may prove a growing demand of the Polish society for highly processed cereal based goods;
4. Among the causes of the current state of the market in cereals the main driver seems to be the development of the situation on the world market. Despite extensive intervention system, the EU countries as a result of the globalization process, they aren't able to effectively lead the CAP;
5. The most significant correlations between the analyzed parameters may include: a positive dependence between production volume and crop yields as well as an arable area and sown crops, and a negative correlation between consumption and use of industrial crops.

Abstract

Cereal Market before and after the Integration of Poland into the European Union. Dynamics of Supply and Demand Correlations

The purpose of this publication is to show some changes in supply and demand correlations on the cereal market after Poland's accession into the European Union. To meet the above objective there were compared some data concerning the volume of domestic cereal production and its cereal species structure, foreign trade balance, domestic consumption and purchase price levels. The formation of the above mentioned items was analyzed for two periods. The first one covered the years 1995-2003 whereas the second one was from 2004 to 2012. This allowed us to make some interesting comparisons through the prism of Poland's accession to the EU. Additionally, long time series increased their reliability. To study supply and demand correlations, there were applied various statistical methods including dynamic indexes, trend models, analyses of correlation and various regression.

A comprehensive analysis of the gathered research material allowed us to answer the question about some quantitative and qualitative changes which took place on the cereal market after Poland's accession to the EU.

Key words: *food economy, agricultural markets, farming, cereal market, European integration.*

Streszczenie

Rynek zbóż przed i po integracji Polski z Unią Europejską. Dynamika relacji popytowo-podażowych

Celem niniejszej publikacji jest ukazanie zmian w relacjach popytowo-podażowych po wstąpieniu Polski do Unii Europejskiej na rynku zbóż. Aby zrealizować powyższe zadanie zostały porównane dane dotyczące wielkości krajowej produkcji zbóż oraz jej struktury gatunkowej, salda handlu zagranicznego, zużycia krajowego, a także poziomu cen skupu od rolników. Kształtowanie się wymienionych wielkości zostało przeanalizowane dla dwóch okresów. Pierwszy z nich obejmował lata 1995-2003, a drugi zaś zawierał się pomiędzy rokiem 2004, a 2012. Pozwoliło to na dokonanie interesujących porównań poprzez pryzmat akcesji Polski do UE. Z kolei długie szeregi czasowe podniosły ich wiarygodność. Do zbadania zachowania się relacji popytowo-podażowych zostały wykorzystaną wielorakie metody statystyczne, wśród których znalazły się m.in. indeksy dynamiczne, modele trendu, analizy korelacji oraz regresji wielorakiej. Kompleksowa analiza zebranego materiału badawczego pozwoliła odpowiedzieć na pytanie jakie zmiany ilościowe i jakościowe dokonały się na rynku zbóż po akcesji Polski do UE.

Słowa

kluczowe: *ospodarka żywnościowa, rynki rolne, rolnictwo, rynek zbóż, integracja europejska.*

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