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CEREALS PRODUCTION AND PRICE IN THE EUROPEAN UNION

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Abstract

The paper aimed to analyze cereals production and price at farm gate, also farm inputs prices (seeds, fertilizers, plant protection products, fuel and herbicides) in the EU in the period 2016-2021 and also partially in 2022 in order to identify the trends in the main cereals producing countries France, Germany, Poland, Romania, Italy, Spain and Hungary and to propose a few alternatives to farmers how to adapt to climate change for sustaining production. Eurostat data regarding cereals production and price at farm gate and also prices for farm inputs were used, graphically illustrated including trend regression equation and coefficient of determination. The results pointed out that EU cereals output accounted for 272.6 million tonnes in 2022, being by -8.2% lower than the peak of 2019. Wheat and maize production is 128.19 million tonnes and, respectively, 55.1 million tonnes, meaning lower levels than before. Cereals output declined in the main producing countries: France, Germany, Romania, Spain, Italy, Hungary, but increased in Poland. High temperatures, heat waves, severe and long droughts, low precipitations were the main causes related to climate change. Cereals price at the farm gate increased, and also production costs went up due to the raise in farm input prices which started since 2021 and exploded in 2022. High price for diesel, seeds, fertilizers, plant protection products, herbicides, were recorded compared to their levels in 2015. The highest increase of producer's price ranged between +60.7% in Hungary and +31.8% in Spain. In Romania it was +40%. Compared to 2015, in 2021, the growth rate of farm inputs price was: +15.8% for diesel, +10.8% for seeds, +9.8% for fertilizers, +5,13% for herbicides and +3% for plant protection products. In the future, farmers have to increase production rethinking cereals structure, using more high potential varieties and hybrids, resistant to drought, diseases and pests; to extend biodiversity and use crop rotation to preserve soil nutrients; to implement technologies with fewer inputs and conservative agriculture for assuring the sustainable development of cereals production, protecting environment and preserving biodiversity.

Key words**:** *cereals production, climate change, producer's price, farm input prices, European Union*

INTRODUCTION

Cereals are very important at the global level to sustain population and farm animals life, and also for biofuel [27].
Wheat, maize and rice are the main three cereals cultivated due to their important role in human diet, but also in animal feeding.
Climate change has a more and more negative impact from a year to another, affecting cereals production and not only on large surfaces.
To protect environment against pollution (air, water, soil), agricultural systems and ecosystems have to reconcile N inputs to not exceed the imposed thresholds and improve N management to diminish gas emissions and sustain a more efficient use of N by crops [49].
Due to global warming, cereals production was diminished and the FAO's forecast regarding the world cereals' output had to be reconsidered in the year 2022 and estimated at 2,764 million tonnes, of which wheat is expected to reach 783.8 million tonnes [20].

Europe is a large user and importer of grains, pulses and oilseeds. The EU cereals farming has been deeply influenced in a negative sense by the global warming and the terrible unfavourable weather conditions in the recent years, mainly in 2020, 2021 and more intensively in 2022.

While agricultural sector was facing higher costs and prices and supply shortfalls to the unfavourable weather conditions, the demand for cereals remained high [3].

Cereals business has come into a risky and uncertain situation concerning the production costs as a consequence of higher prices for farm inputs which started from 2021 fall and the situation was amplified by the conflict between Russia and Ukraine which increased fuel and energy prices with a negative effect on all the other prices in the economy.

The European Parliament has made the recent assessments which confirm a diminished cereals production in the EU main producing countries due to the extreme meteorological phenomena, mainly concerning high temperatures, heat waves and long and serious droughts [12, 8].

The surface cultivated with cereals dropped below the five-year average and production is expected to decrease significantly [6].

More than never before, scientific research is called to look for solutions to the big problems of agriculture in the actual critical context facing energy crisis, farm inputs crisis, price crisis, food crisis and health crisis, when agriculture needs to be helped to assure food for the global population [23].

Comparatively analyzing the EU safety net policies, alternative transparent, predictable and fair solutions could be helpful to reduce farm income downside risks on an EU countries [2].

Diversification of crop structure, taking into consideration old cereals forgotten for years, resistant to drought, diseases and pests could be an alternative. For example, *Triticale* should be an option in some areas where wheat cannot resists to extreme temperatures and dryness and research is called to offer cultivars and hybrids of high productivity and also resistant to drought, diseases and pests [50].

Another example is *Sorghum bicolor* which could be cultivated for its grains, and used in food for humans, animal feed and ethanol production. Therefore, it could replace a part of cereals like wheat for humans and animals, and also a part of maize for animal feeding and in ethanol production [37, 38, 40, 42].

Farmers have to decide on what surfaces these crops could be cultivated and what new technologies could be implemented and estimate yields and production costs [20].

Biodiversity should be extended and improved to help the farmers to increase efficiency in cereals production, but not only!

Despite that monoculture enabled farmers to use machinery, increasing the efficiency in planting and harvesting, it has become a controversial subject in today's agriculture. Policulture have many advantages among which could be mentioned: erosion limitation, a better storage of carbon into the soil, reduced nitrogen in water, sustained biodiversity below and above the soil. Therefore, crop rotation is in the benefit of farmers, environment and biodiversity [1, 52].

New technologies with fewer inputs have to be delivered to farmers helping them to optimize costs, sustain production and obtain high quality products and their business to be economically viable. Precision agriculture helps the farmers to apply the latest technology destined to produce food using fewer inputs and natural resources. Also, it allows gene editing, to watch plant development and use crops resistant to diseases and drought. The use of seeds, fertilizers and products for plant protection could be kept under control by precision technologies which are environmental friendly [22].

Conservative agriculture could be an option for crop farming assuring increased yields, with low costs, labor savings, carbon sequestration, healthier soils, improved biodiversity, sustainability. [24, 25, 26].

Green Deal established by the EU Commission emphasizes that the future agriculture has to be more friendly with the environment, and in this respect, organic farming should be practiced on larger surfaces and also new technologies with reduced

chemical fertilizers and pesticides or with organic products for sustaining soil fertility, production and product quality are required [39, 45, 46, 47].

In this context, the aim of the paper was to analyze cereals production and price at farm gate, also the farm inputs prices (seeds, fertilizers, plant protection products, fuel and herbicides) in the EU in the period 2016-2021 and also partially in 2022 in order to identify the trends in the main cereals producing countries France, Germany, Poland, Romania, Italy, Spain and Hungary. In the paper there are pointed out the causes of the decline in cereals production related to the negative impact of climate change. Also, the dynamics of cereals price at farm gate and the farm input prices were analyzed in each country. Finally, there were made some proposals how farmers should adapt cereals farming to climate change for sustaining production.

MATERIALS AND METHODS

The paper is based on a large information collected from various publications like scientific articles, FAO and European Commission reports. Eurostat data base was used for collecting the statistical data.

The main studied indicators have been:

Cereals production at the EU level in the period 2016-2022, and also in the main cereals producing countries: France, Germany, Poland, Romania, Italy, Spain and Hungary.

Suggestive graphical illustration were made to identify the difference in each country from a year to another.

Cereals prices taken into consideration in this study have been expressed in price indices, calculated in comparison with the price level in the year 2015, considered as a fixed basis.

The analysis regards:

-producer's price or price at the delivery at the farm gate;

-farm input prices, concerning: seeds, NPK fertilizers, products for plant protection against diseases, pests and herbicides, fuel.

The analysis is approached both at the EU level, and also in each country from the group mentioned above.

The climate changes in terms of extreme meteorological events was also described to justify why cereals production declined in the EU and in each main producing country.

Also, there are explained the causes why the prices increased during the last years.

Finally, there were given some recommendations to farmers how to reduce the impact of climate change and sustain cereals production.

RESULTS AND DISCUSSIONS

In the EU, cereals production has a decreasing trend due to the climate change that had a deep impact by means of high temperatures, heat waves, low precipitations, long and strong drought, water shortages which created crop stress and cut the yields not only in case of cereals but also for other plants and in animal sector as well.

These extreme weather phenomena have been more intensive in the years 2020, 2021 and 2022. Compared to the maximum cereals output recorded by the EU in the year 2019 and accounting for 299.36 million tonnes, in the year 2022 the obtained production is 272.6 million tonnes, meaning by 8.24% less. In comparison with the output carried out in the year 2020, 286.5 million tonnes, in 2022 the volume of production was by 4.9% smaller. However, compared to the year 2016 level, the reduction is only 1.8%.

Wheat is the major cereal grown in the EU and it accounts for about 50% of production, and the other half is represented by maize and barley summing one third and finally other cereals like rye and oats [7].

Wheat production decreased from 137.13 million tonnes in the year 2016 to 128.19 million tonnes in 2022, reflecting a loss of 6.52%, but compared to the peak of production achieved in the year 2019, accounting for 139.62 million tonnes, this means by 9.2% less in 2022.

Maize for grains production also declined, in 2022 accounting for 55.10 million tonnes, being by 12.5% lower than in the year 2016, and by 24.8% smaller than in the year 2021, when the EU harvested the highest output, meaning 73.19 million tonnes (Fig. 1).

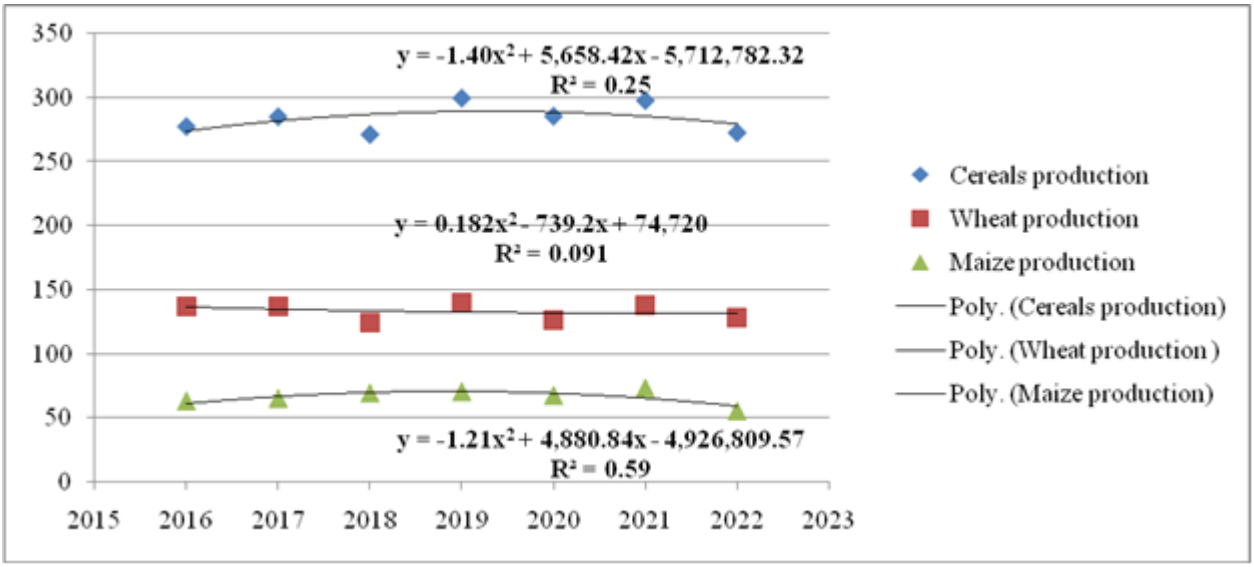


Fig. 1. Dynamics of cereals production, wheat and maize productions in the EU, 2016-2022 (Million tonnes)
Source: Own design and calculations based on the data from [8].

As a consequence, the share of wheat as well as of maize in the EU cereals output declined from 49.4% in 2016 to 47% in 2022 in case of wheat, and from 22.7% to 20.2% for maize.
The main cereals producing countries in the EU are France, Germany, Poland, Spain, Romania, Italy and Hungary and also United Kingdom till Brexit.
The situation of cereals production in these countries in 2022, compared to the peak of output recorded in the year 2019, changed as follows:

- France was facing a decline in cereals output by 14.31% from 71,208 thousand tonnes in 2019 to 61,023 thousand tonnes in 2022.
-Germany registered only 4.13% decrease in cereals output from 44,329 thousand tonnes in 2019 to 42.50 thousand tonnes in 2022.
-Poland is the only EU country that registered a higher cereals production in 2022, accounting for 36,000 thousand tonnes, by 24.18% more than 28,990 thousand tonnes in 2019.

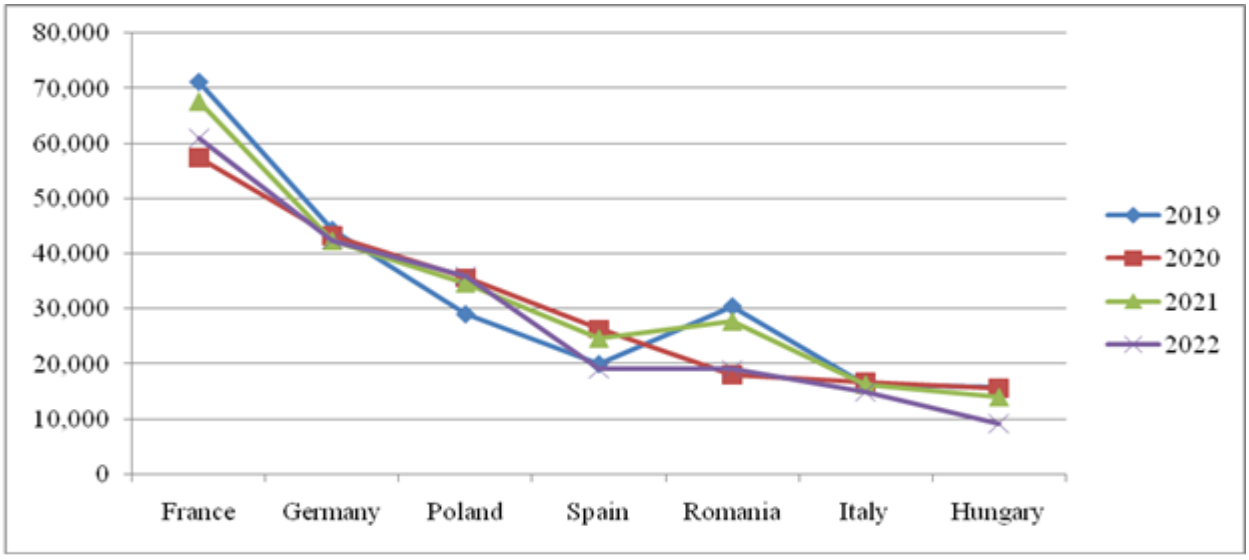


Fig. 2. Dynamics of cereals output in the EU main producing countries, 2019-2022 (Thousand tonnes)
Source: Own design based on the data from [13].

-Spain recorded a production by -4.06% lower in 2022, more exactly 19,133 thousand tonnes, compared to 19,942 thousand tonnes in 2018. But, in comparison with the peak of

26,389 thousand tonnes in the year 2020, this means a loss of 27.5% of grains.

-Romania also was facing a substantial reduction in cereals output. It accounted for -37.07% in 2022, as production level was only 19,140 thousand tonnes compared to the highest production of 30,412 thousand tonnes achieved in 2019.

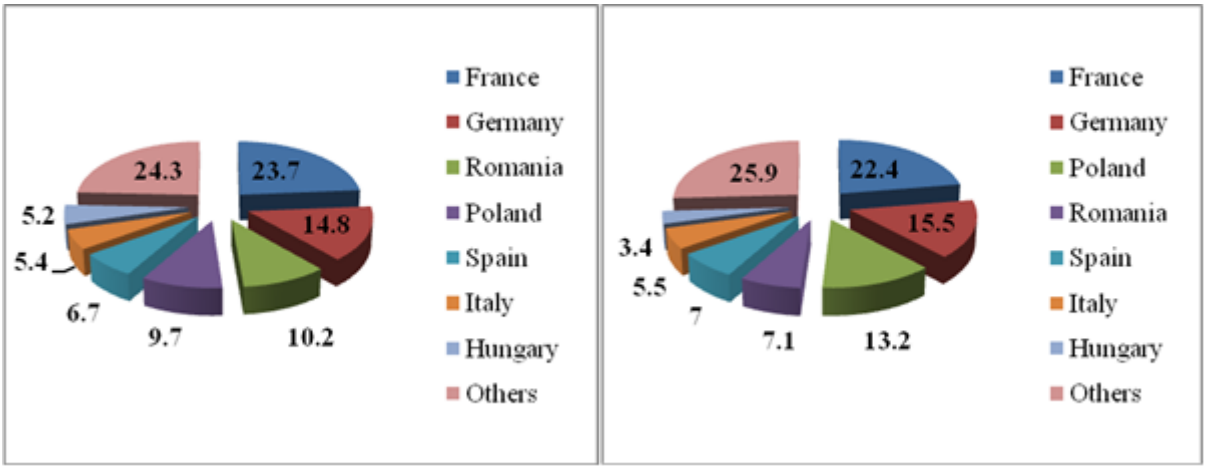
However, Romania is one of the most important cereals producers in the EU. It has a high potential as large surfaces are cultivated with maize, wheat, barley, rye etc., high production performances were recorded in many years, but the last period of time the long droughts caused by high temperatures and low annual precipitations diminished yields and harvests [32, 35, 36, 43].

-Italy was another country which obtained lower results. In 2022, it harvested 14,996 thousand tonnes cereals, by -7.05% less than in 2019, when its production was 16,132 thousand tonnes.

-Hungary registered 9,224 thousand tonnes cereals in 2022 by -41.25% less than in 2019, when the grain output accounted for 15,698 thousand tonnes (Fig. 2).

The share of the main producing countries in the EU cereals output in 2022 compared to 2019 is shown in Fig. 3. The figures show that France keeps it top position, followed by Germany. In 2022, Poland passed on the 3rd position, while Romania went down on the 4th one. Spain, Italy and Hungary remained on their places: the 5th, 6th and 7th.

All these countries together contributed by 74.02% to the EU cereals production in 2022.



In 2019 In 2022

Fig. 3. The contribution of the major producing member states to the EU cereals production in 2022 versus 2019 (%)
Source: Own design and calculation based on the data from [13].

The main weather phenomena which reflected climate change and its negative impact on cereals production

Climate change have had a more intensive impact on agricultural performance, in the present case, on cereals production.

Some studies on the influence of the climate on cereals production proved the existence of a negative correlation between the high temperatures and yields and a positive relationship between precipitations level and production performance [48].

The extreme weather events in Europe during the last years have been an "alarm bell" regarding the global food security crisis, as long as the European farmers have to struggle to produce and survive.

Wheat and maize next to rice form "the crop trilogy" with the largest importance in assuring the global food.

Europe was facing extreme weather phenomena like: heat waves from Africa, lack of rainfalls, long and severe droughts, even pedological droughts, strong storms as it happened in Italy, France, Spain, Romania in 2022, which could be considered the worst year for agriculture.

The unfavorable weather conditions have been noticed even since winter of the year 2020 which was a mild season with low

precipitations level and a low snow layer not able to ensure enough moisture into the soil which did not allow the crops to grow sufficiently especially in their early stages of vegetation.

The spring of 2021 continued with relatively low precipitations and crops continued to suffer during their vegetation period.

The summer continued with a long period of high temperatures and drought and even the autumn season was warm and with low precipitations which caused problems to farmers while they were preparing the land for sowing.

The winter of the year 2021 was again a mild season with low precipitations so that the soil was dried up by water to a depth of about 80-90 cm, a real pedological drought as it happened in a few Eastern and Southern countries so that the farmers had to start sowing for the spring crops in delay.

The 2022 summer was hot and brought several heat waves and the long drought has deeply affected maize for grains, but also sunflower, crops which have been under a continuous stress.

In some regions, the ground cracked, the reserves of water for irrigation were diminished so that the authorities imposed restrictions regarding the use of irrigation water and more than this, in some regions, the rivers, lakes and irrigation canals have dried up and irrigations could not be applied.

The most affected countries have been the Mediterranean ones: Spain, France, Italy, Greece, but also countries from the Eastern part of Europe like Romania and Hungary.

In consequence, the yields were cut and the harvested output was lower than before as the statistics proved [10].

In the EU, the prolonged drought, associated with soil moisture deficit in combination with vegetation stress have led to the decline in agricultural production [9].

In Italy, the heat stress, terrible drought and low precipitations reduced the yield per hectare and implicitly the grain harvest. The production of Durum wheat was very much affected, which diminished the deliveries to processing industry which was obliged to import wheat [11, 21, 28].

In Spain and Hungary, extreme heat and drought diminished wheat and barley production, while in Hungary, Romania, France, Italy and Germany, maize for grains was the most affected cereal.

Poland had relatively favourable weather conditions which allowed to perform in cereals production and to win its 3rd position as producer after France and Romania [4, 28].

In France, the most disturbing extreme meteorological events were heats, the dry summer, strong storms, and huge rains which caused enormous damages to cereal farmers and not only [28].

In Spain there were similar meteorological phenomena: high temperatures which led to water shortages, and restrictions for water use were imposed [28].

In Germany, the mild spring with low precipitation levels and summer drought has deeply affected maize production which was below the level of the period 2014-2021. Also, other crops have registered yield cuts and this determined the farmers to continue to adapt the crop technologies according to the weather conditions [51].

In Romania, it was a huge deficit of water into the soil even since the winter season in 2021 and also in 2022, a few weak rains at the beginning of spring, but not enough, high temperatures starting since June till late in autumn, heat waves, a long and terrible drought, water shortages, which cut the maize yield and also for other crops like sunflower.

In 2022, about 300,000 ha were affected by drought of the 7 million cultivated with cereals.

The decline of cereals production accounts for 15-18% compared to the 2021 level.

There are regions in Romania were the deficit of water is very high like in Dobrogea, Eastern part of the country [5, 31, 32, 33, 43].

Cereals price and its factors of influence

As it is unanimously recognized, price at farm gate is influenced by production costs whose level depends on crop, applied technology, technical endowment, labour.

The variables costs have the highest share in production costs and, besides gross products, they influence gross margin per hectare in vegetal farming [29, 30, 41].

High production potential seeds, especially certified, from high value hybrids, fertilizers (Nitrogen, Phosphorus and Potassium, but especially Nitrogen-based), specific products against crop diseases and pests, herbicides, diesel for machinery (tractors, combines), irrigation water etc are the main farm inputs with the highest share in the variable costs.

The price of each component of variable costs has increased during the last years and especially in the fall of 2021 leading to a higher producer's price. And cereals farming was not bypassed by the increased price of farm inputs.

In addition, cereals price boosted in the year 2022 due to the conflict between Russia and Ukraine, the both countries being major cereals producers.

The inflated diesel price caused a chain reaction determining a higher selling price of all the farm inputs, a high production cost, also increased producer's price and production costs in the milling and bakery industry. In consequence, the price of bread and bakery products also went up affecting the daily basket structure and cost in close relation to consumer purchasing power [44].

The price of fertilizers as well as of plant protection products increased not only due to the inflated prices of raw materials, but also due to energy crisis, mainly regarding gas and electricity costs and also transport costs related to high fuel price [21].

This started from the fall of the year 2021, but the price boom was intensified by the conflict between Russia and Ukraine, so that prices have reached new heights in the 2022 autumn, deepening the cost of living [28].

Besides the negative impact of climate change, which diminished cereals production, but also agricultural output in general, farmers were facing with the price burden and stress, a new attempt that calls into question the future production of the next agricultural year 2022-2023.

Cereals supply and trade has suffered disruptions with a deep impact in providing cereals and other goods to the countries in need.

In this situation, food cost and implicitly food price have exploded resulting a reduction in consumption.

Cereals average annual price at farm gate in the EU

Cereals producer's price was deeply influenced by products costs, in their turn depending on farm input prices for certified seeds, NPK fertilizers, herbicides, plant protection products against diseases and pests, fuel and other factors like technologies applied, local soil and climate conditions, farms size, technical endowment, labor force which varied from an EU member state to another and from a region to another.

The analysis of the cereals price indices made in the period 2016-2021 reflected that cereals producer's price increased at the EU level by +37.03% in 2022 compared to the 2015 level considered 100.

The growth of producer's price differs from a country to another as follows: +60.76% in Hungary, +46.69% in Poland, +39.97% in Romania, +37.27% in France, +36.9% in Germany, +34.6% in Italy and +31.85% in Spain. Wheat and maize price has a high volatility linked to demand/offer ratio but also in the context of international markets [34]. (Fig. 4).

Price indices for seeds reflected an increase by +10.88% in 2021 compared to price level in the EU in 2015.

If in France, price indices reflected a lower level of the seed price than in 2015, in all the other main cereals producing countries, price indices showed important growths especially in the period 2018-2021, as follows:

-In Romania, the seeds price was lower than in 2015 in the years 2016 and 2017, but in the coming years, it exceeded the 2015 level by: +41.8% in 2018, +34.88% in 2019, +51.04% in 2020 and + 45.71% in 2021.

-In Hungary, also the price indices for seeds were higher than in 2015 by +1.8% in 2018 and up to +16.8% in 2021.

-In Italy, the price indices reflected that seeds price increased compared to its 2015 level, the growths ranging between +1.6% in 2018 up to 14.5% in 2021.

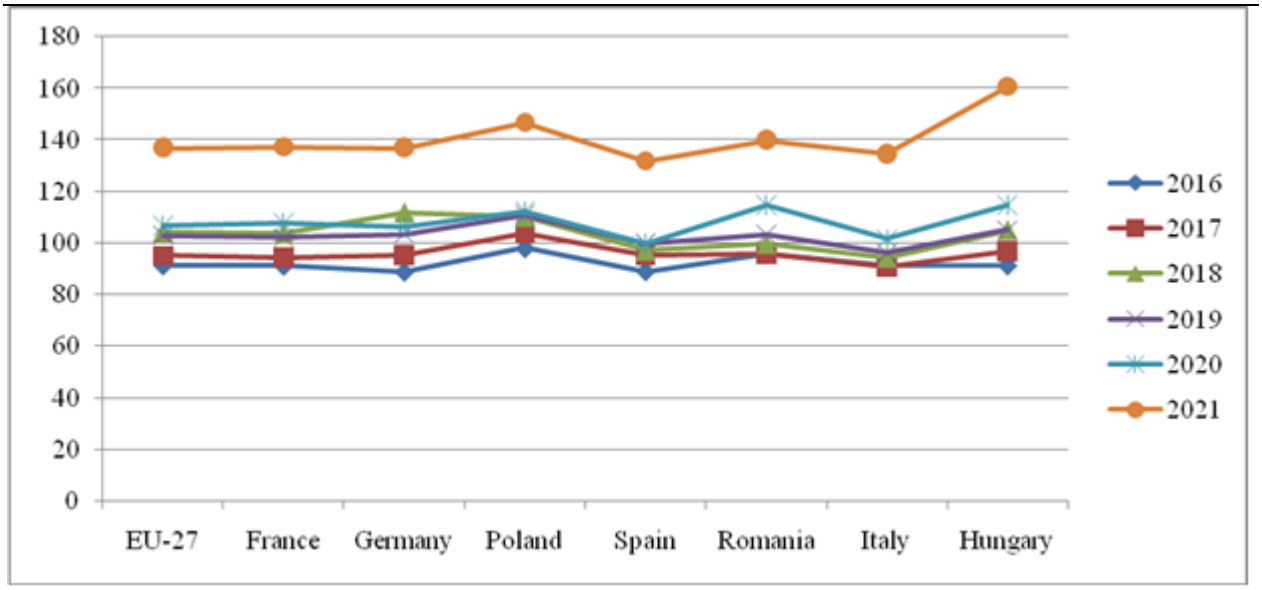


Fig. 4. Cereals price indices in the EU main producing countries, 2016-2021 (%), 2015=100
Source: Own design based on the data from [14].

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-In Italy, the price indices reflected that seeds price increased compared to its 2015 level, the growths ranging between +1.6% in 2018 up to 14.5% in 2021.

-In Poland, the seeds had a price higher than in the year 2015 starting from the year 2017 by +1.39% and reaching + 12.93% in 2021.

-In Germany, the seeds price indices were smaller than 100 in the interval 2016-2018, but in 2019 and 2020 they reflected that seeds were more expensive by +2.3% in 2019 up to +10.7% in 2021.

-In Spain, compared to 2016, the cereals seeds prices were higher in the whole period 2016-2021 by various percentages varying between +4.3% in 2020 up to 5.9% in 2021.

-In France, in each year of the studied interval, the price indices for seeds were below 100, reflecting no increases compared to their level in 2015 (Fig. 5).

Price indices for NPK fertilizers raised at the EU level by +9.87% only in the year 2021 compared to their level in 2015, and in all the other years the fertilizers had lower prices than in the year of reference.

However, in the main cereals producing countries, NPK fertilizer price varied from a country to another as follows:

- In Romania, in 2016, the fertilizers price was below the 2015 level. But, starting since 2017, NPK fertilizers had a higher price which led to a higher production cost. The lowest price growth was +0.57% in the year 2020, but in 2017, the increase accounted for +22.4%, in 2019 for +13.17% and in 2021 for +28.88%.

-In Hungary, the NPK fertilizers price was lower in the period 2016-2020 than in 2015, but in 2021, its level was by +15.6% higher.
-In Poland, the fertilizers price was smaller than in 2015 in the interval 2016-2018, but then it increased in the following three years by +1.22%, +0.58% and +10.7% respectively.
-In Italy, the fertilizers price was higher only in the year 2021 when its growth accounted for +10.3% compared to 2015.
-In Spain, also in the year 2021, the fertilizers price was by +6.2% higher than in 2015.
-In France, in 2021, NPK fertilizers become more expensive than in 2015 by +5.76%, but in all the other years, their price was smaller than in the year of reference (Fig. 6).

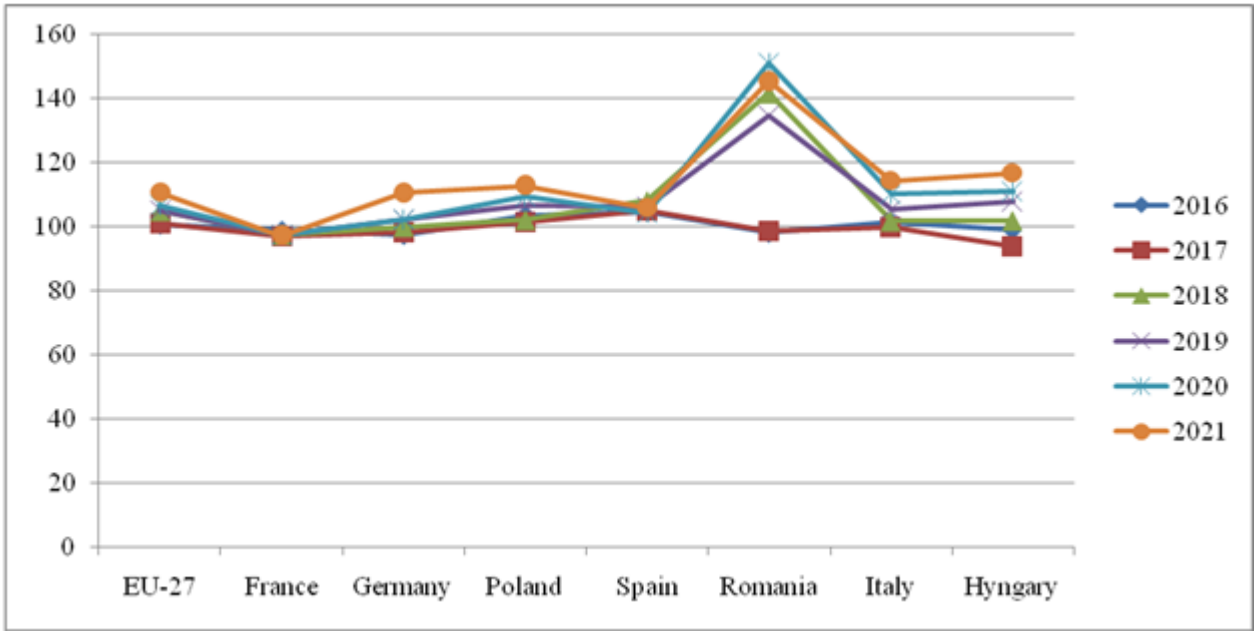

Fig. 5. Price indices of the means of agricultural production, Seeds input (2015 = 100) - annual data in the EU main producing countries, 2016-2021 (%), 2015=100
Source: Own design based on the data from [15].

Price indices for plant protection products and pesticides, compared to their level in 2015, in the next years they reflected higher levels. In the EU, the price growth ranged between +1.14% in 2016 up to +3.12% in 2021.
Price increases were noticed in all the main cereals producing member states, but with different percentages from a country to another.
-In Romania, the growth of the price for plant protection products varied from +14.64% in 2019 up to +43.98% in 2021, versus its level recorded in 2015.
-In Hungary, the lowest price growth accounted for 1.2% in 2016 and the highest one for +15.1% in 2021.
-In Poland, the price registered increases which ranged between 1.22% in 2016 and +11.73% in 2021.
-In Italy, the price of this category of farm inputs registered growths which varied between +2.4% in 2016 up to +11.4% in 2021.
-In Spain, the price was higher by +0.3% in 2016 and up to +7.1% in 2021.
-In Germany, the price for plant protection products registered a higher level than in 2015 by +0.7% in 2016 and up to +7.3% in 2021.
-France is the only country where the price of plant protection products was lower in 2021 compared to its level in 2015 (Fig. 7).

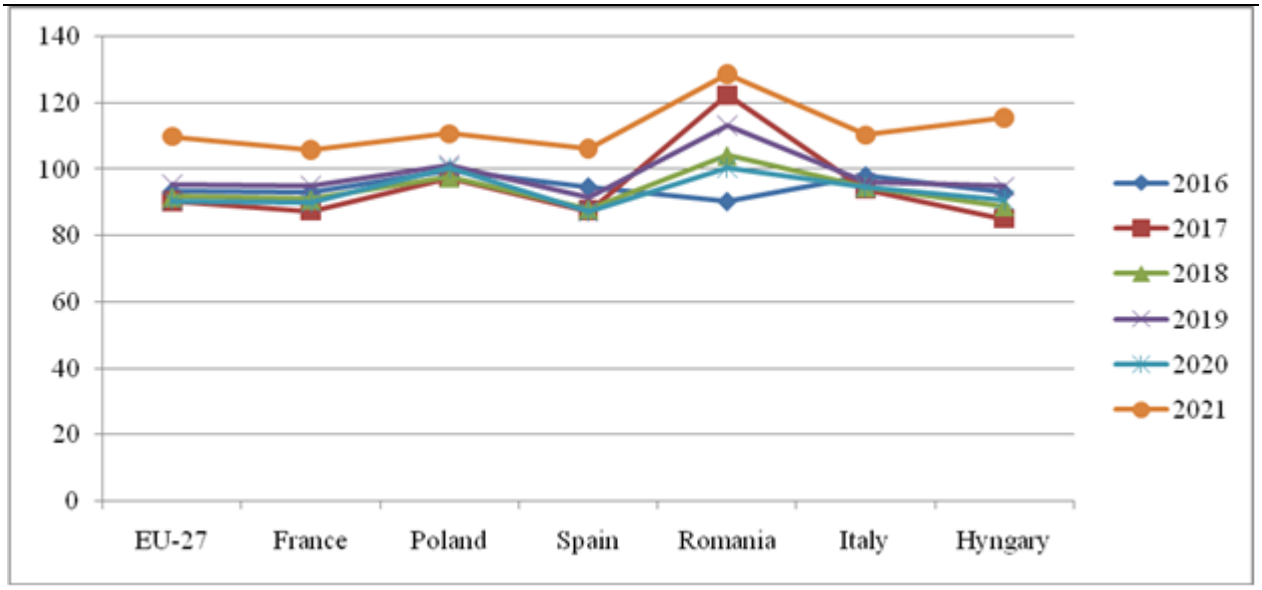

Fig. 6. Price indices of the means of agricultural production, NPK fertilizers input (2015 = 100) - annual data in the EU main producing countries, 2016-2021 (%), 2015=100
Source: Own design based on the data from [16].

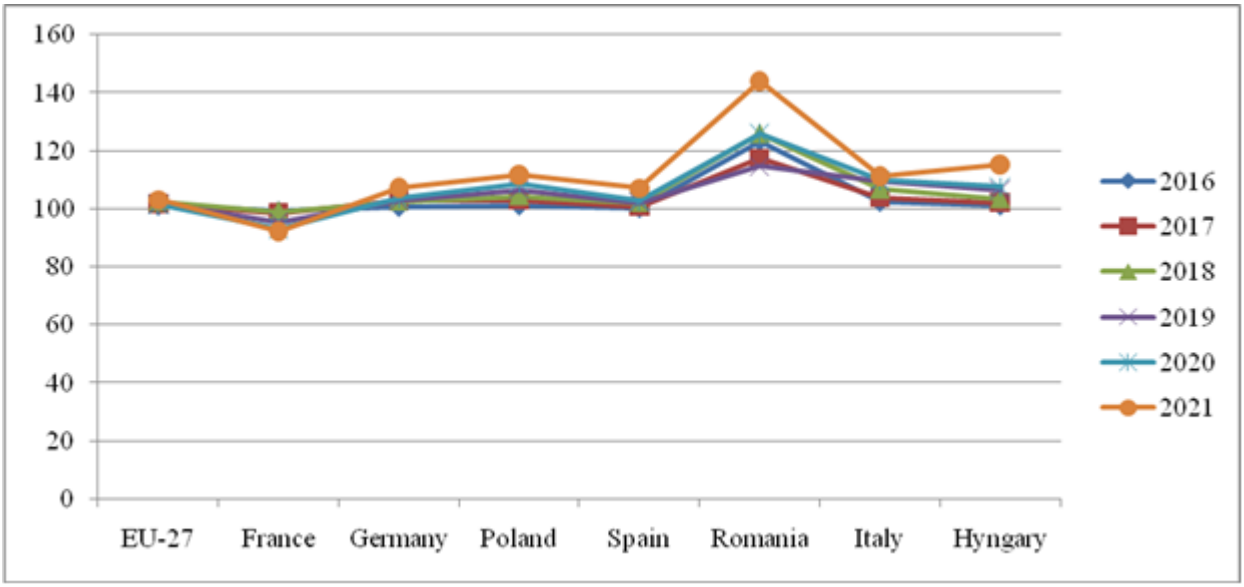

Fig. 7. Price indices of the means of agricultural production, Plant protection products input (2015 = 100) - annual data in the EU main producing countries, 2016-2021 (%), 2015=100
Source: Own design based on the data from [17].

Price indices for fuel exceeded their level in 2015 in the EU, starting from 2018, the growths varying between +12.27 in 2019, +11.96% in 2018 and +15.82% in 2021.
In 2020, the price was smaller than its level in 2015.
The situation of fuel price differs from a country to another.
-In Poland, fuel price was smaller than in 2015 only in the year 2016, but in the coming year, it registered different increases ranging between +2.33% in 2017 up to +24.68% in 2021.
-In Hungary, in the years 2016 and 2017, fuel price was smaller than in 2015, but then, it recorded growths which varied between 2% in 2020 up to +23.8% in 2021.
-In France, except the year s 2016 and 2020, when fuel price was lowers than in 2015, in the other years it raised by +2.26% in 2017, +22.2% in 2018, +20.09% in 2019 and +21.09% in 2021.
-In Germany, the fuel price was below its 2015 level only in 2016, 2017 and 2020. In the other years, it increased by +9.8%, 8.6% and 17.7% respectively.

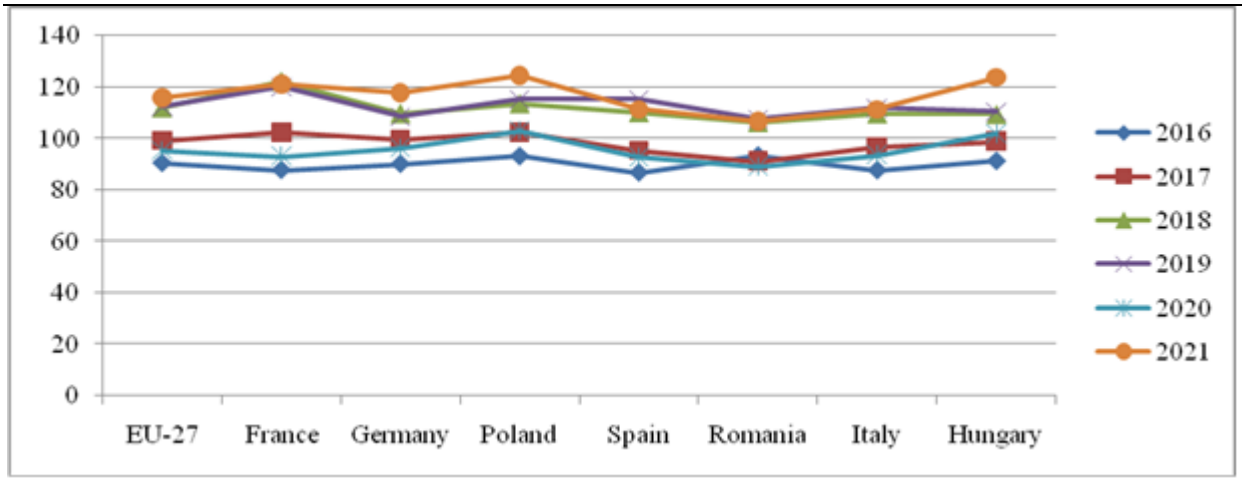

Fig. 8. Price indices of the means of agricultural production, Fuel input (2015 = 100) - annual data in the EU main producing countries, 2016-2021 (%), 2015=100
Source: Own design based on the data from [18].

-In Spain, also in 2016, 2017 and 2020, the fuel price was below its 2015 record. But, in 2018 it increased by +10.1%, in 2019 by +15.3% and in 2021 by +11.3%.
-In Italy, the fuel price was smaller than in 2015 in the years 2016, 2017 and 2020, but it became by +9.68% higher in 2018, by +9% higher in 2019 and by +11.3% in 2021.
-In Romania, the fuel price increased by 6.25% in 2018, by +7.55% in 2019 and by +6.57% in 2021, but in all the other years it was below its 2015 level (Fig. 8).

Price indices for herbicides increased in the EU by +0.88% in 2016 up to +5.13% in 2021 compared to the year of reference 2015.
-In France, the annual herbicides price in the period 2016-2021 was a little lower than in 2015.
-In Romania, where weeding causes many problems to farmers and the demand of herbicides is high, their price also raised with rates ranging between +1.39% in 2017 up to +55.3% in 2021.
-In Hungary, the growth of herbicides prices varied between +0.8% in 2016 up to +21.3% in 2021.
-In Poland, the growth rate for herbicides prices ranged between +1.5% in 2016 up to +13.3%5 in 2021.
-In Italy, the herbicides were more expensive than in 2015 by a growth rate varying between +1.2% in 2016 up to +9.7% in 2021.
-In Spain, in 2016 and 2017, herbicides had lower prices than in 2015. In the next years, the price increased by rates ranging between +1.2% in 2019 up to +7.5% in 2021 (Fig. 9).

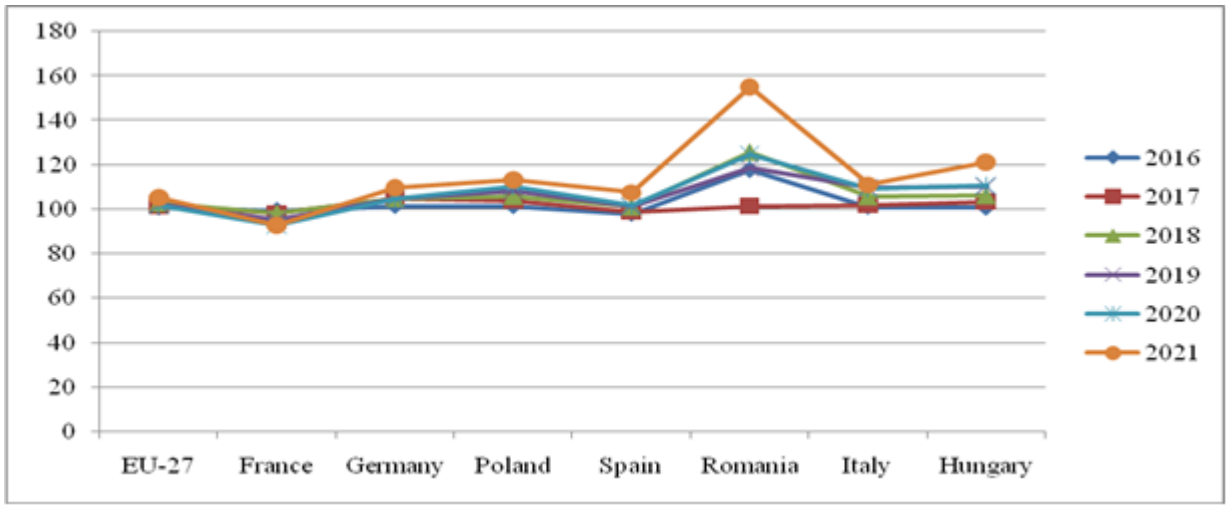

Fig. 9. Price indices of the means of agricultural production, Herbicides input (2015 = 100) - annual data in the EU main producing countries, 2016-2021 (%), 2015=100
Source: Own design based on the data from [19].

CONCLUSIONS

Cereals production in the EU has registered a decline in the last years as a result of the negative impact of climate change.

The growth of the cereals price is explained by the increase of the production costs determined by the fact that farm inputs have become more costing in the last years and especially in the year 2021.

Cereals price at farm gate increased in almost all the EU member states.

The price of farm inputs raised in almost all the EU countries, but the highest price growth rates were noticed in Romania and Hungary, and smaller growths in the other countries.

The year 2021 is the most critical year characterized by a boom in farm input prices in the EU and the main cereals producing countries.

Compared to 2015, in 2021, the growth rate of farm inputs price was: +15.8% for diesel, +10.8% for seeds, +9.8% for fertilizers, +5,13% for herbicides and +3% for plant protection products.

The year 2022 has amplified prices and production costs in agriculture, cereals farming being included, but also in other economic fields affecting the cost of living.

As price level is difficult to manage by farmers due to the international conjuncture factors, farmers have to be more oriented to the adaptation of their business to diminish the negative effects of climate change.

In this respect, farmers have to be helped by scientific research which have to put at their disposal effective solutions to increase cereals production and grains quality as follows:

-to use new varieties and hybrids of high production potential, resistant to drought, diseases and pests;

-to diversify cereals crops, using much more the ones resistant to drought, diseases and pests;

- to calculate the optimal areas on which the new cereals could be cultivated and estimate yields and production costs;

- to extend biodiversity and preserve soil nutrients by practicing crop rotation and avoiding monoculture;

-to use technologies with fewer inputs which means lower costs, labour saving, environment protection and sustainable development;

-to practice conservative agriculture on larger surfaces for obtaining higher productions and protecting environment.

As mention in Farm to Fork Strategy, and Green Deal, the EU describes that the future belongs to a more sustainable agriculture of high performance called to assure food safety and security and also environment conservation and biodiversity preservation.

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