

SUSTAINABILITY OF PRODUCTION AND EXPORT OF MAIN CEREAL AND OIL CROPS FROM BULGARIA³

Bulgaria is one of the leading exporters of agricultural crops in Southeast Europe. Though smaller than their neighbours, Bulgarian farmers have a long tradition of growing all main cereals and oil crops, including wheat, maize, sunflower (in 2020 Bulgaria was the seventh largest exporter in the world), rape seed, barley and others. The main objective of the current study is to determine the nature of the considered processes for the production and export of main cereals and oil crops from Bulgaria and to study their sustainability. This is achieved by calculating the coefficients of sustainability of the specific indicators characterizing the processes. Determined is also whether the distribution of the main countries – trading partners is specific. Based on the obtained results, conclusions are drawn about the sustainability of the production and the export of main cereals and oil crops from Bulgaria.

Keywords: cereals; oil crops; agriculture; sustainability; export

JEL: F14; Q10; Q17; Q18

Introduction

Food and agricultural systems are fundamental to the successful and fulfilling development of humanity. As for food security, these systems are necessary not only to ensure safe and healthy food, but also the livelihood and income of a large number of farmers (Ruscheva, Grozdanova, 2021; Kirova, 2020). These systems are integral to rural and economic development (Kotseva-Tikova, 2018). At the core of food security is the production of cereals and oil crops worldwide to meet the growing needs for food, animal feed and biofuels.

The objective of the current analysis is to establish the sustainability of the production and export processes of main cereals and oil crops from Bulgaria. The subject is the production and the export as processes. The object is the sustainability of the production and export processes of main cereals and oil crops from Bulgaria.

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Examined are cereal and oil crops that are in the top 100 of Bulgaria's export list (based on Combined Nomenclature) They include the following 5 crops:

- Wheat and meslin;
- Sunflower seeds, whether or not broken;
- Maize or corn;
- Rape or colza seeds, whether or not broken;
- Barley.

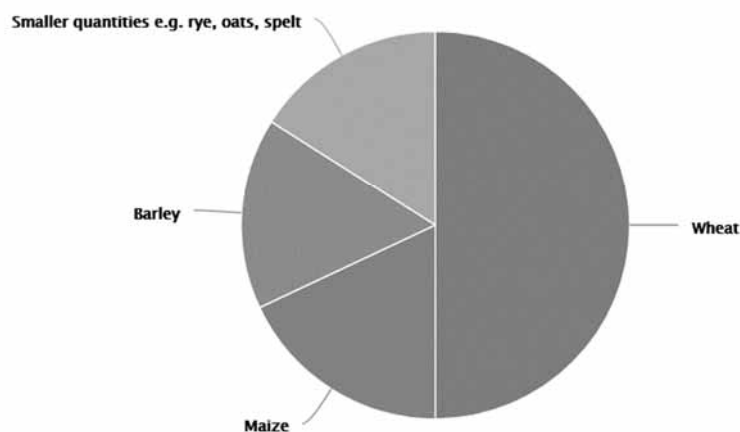
The study period is the last 6 economic years – from 2016 to 2021. For some of the indicators, data for 2021 are not yet available. In these cases, data are used to the available extent.

1. General characteristics of the main cereal and oil crops

Wheat, maize and rice have the main share of the cereal production in the world. In the EU countries, the situation is more or less identical – 50% of the production is wheat, about 17% – barley, about 17% – maize, and about 16% – all other cereals.

Figure 1

Structure of production of main cereals in the EU

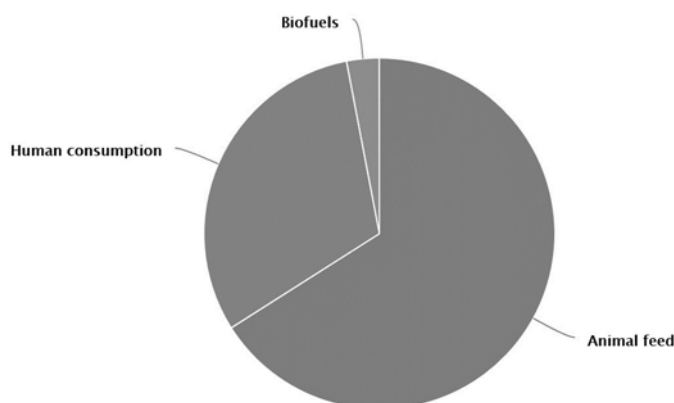


Source: European Commission.

Cereals in the EU are used mainly for animal feed (almost 2/3), 1/3 is intended for human consumption and 3% is used for biofuels (EC, 2022).

Figure 2

Structure of consumption of main cereals in EU



Source: European Commission.

Another significant part of plant species forms the production of oilseed crops in the EU. Oilseeds are used for food, feed, fuel and industrial purposes. They are grown to produce seeds with high-fat content. The oils and meals extracted from them are used in the food industry or for the production of biodiesel, and the meals are an important component for feed.

In the EU, oilseeds are rape seed (59%), sunflower seed and soybean seed. There are no specific measures to support oilseed production. 2/3 of Europe's consumption each year is produced in the member state. However, there remains a significant share of about 1/2 of the oilseeds used annually for animal feed in the EU from non-EU sources, with zero import duties.

Concerning economic importance, the agricultural sector is very important for Bulgaria. According to preliminary data, in 2021, the gross added value (GVA), created in the agricultural sector, amounts to 4950 million BGN, forming 4.3% of the total GVA of the country's economy. In real terms, it marks a growth of 6.1% compared to the previous year (Ministry of Agriculture, Food and Forestry, 2021).

The most significant for Bulgaria is the production of cereal and oil crops. (Dimitrova, 2020) Of the cereals, the main production is wheat and maize. Barley, rye, triticale, oats, millet, sorghum are produced to a smaller extent, and the other crops have rather local importance for a certain region in which they are distributed.

In Bulgaria, traditionally, are produced significantly more quantities of cereal and oil crops than are necessary to meet the needs of the country's consumption. This allows a large export to be realized annually. In 2021, the harvested wheat production increased by 51% on annual

basis to a record of 7.1 million tons. There is also a significant increase in the production of rape seed (34%) and barley (25%), and more moderately – in that of maize for grain and sunflower (by about 14% and 16%, respectively).

The export of maize is one of the most important in the field of food products, and for some countries in the world the import of wheat is vitally important. That is why the development of the cereals and the corresponding amount of harvest in the countries in the world, which are large producers and exporters of wheat, are so carefully followed. Wheat has the largest share in the export of cereal crops, but maize, rape seed, soy and barley are also exported in large quantities.

Russia is one of the biggest exporters of cereals in the world. Together with the USA, Australia, Canada and Ukraine, in the previous agricultural year (July 2020 – June 2021), these 5 countries realized a total of over 58% of the world exports.

The total value of agricultural goods exported from Bulgaria in 2021 is slightly over 6 billion EUR – 25.8% more than in 2020. With a smaller increase in imports (by 10.5%), the traditionally positive balance for Bulgaria in the agricultural trade grows double on an annual basis, reaching nearly 1.6 billion EUR. The leading groups of products in the structure of the agrarian exports in 2021 are cereals and oilseed plants, followed by fats of vegetable or animal origin, residues of the food industry and prepared animal feed, food products based on cereal plants, cocoa products, soft drinks, etc.

As one of the largest producers and traders of cereals in the world, the EU supports farmers with income support, market measures and trade policy under the Common Agricultural Policy (CAP) (Harizanova-Bartos, Stoyanova, Harizanova-Metodieva, 2020). The support has distanced from the principle of what and how much is produced and has become completely disconnected from production (when payments are no longer linked to the produced quantity) (Doitchinova, Miteva, Zaimova, 2019).

Cultivated areas for arable crops are currently integrated into the single common organization of the market and the policy of the EU is limited to two main areas (Kirechev, 2021):

- Intervention by the European Commission and aid for private storage – initially, the measure is introduced to protect farmers against low market prices, the purchase of cereals and rice for storage in public warehouses; now it is used only in emergency situations, providing a safety net for farmers.
- Trade measures – a number of fixed import tariff quotas are introduced with lower or zero duties.

2. Methodology

The main indicators characterizing the production of main cereals and oil crops are:

- Harvested areas;
- Production;

- Producer price.

On the other hand, the indicators characterizing the exports are:

- Exported quantities;
- Unit price;
- Export value;
- Share in the world exports;
- Main trading partners.

The sustainability of the process is examined in order to determine the nature of the studied production and export processes. This is done by calculating the sustainability coefficients of the specific indicators characterizing the processes.

To study the sustainability of an economic process, Nestorov (2021) suggests the following definition: “sustainable is an economic process that changes rectilinearly”. Since, in economic practice, completely rectilinearly changing processes are rarely found, Nestorov proposes the statement that “a given economic process is more sustainable the closer its change is to the rectilinear change” (Nestorov, 2021). He also suggests a coefficient for measuring the sustainability of a process, representing the coefficient of correlation between the actual values of the studied time series and its values smoothed by the method of least squares for a linear function (can be shown by a straight line in a figure):

$$Y=a_0+a_1t \quad (1)$$

where:

Y is estimated values of the variable;

a_0 and a_1 – regression coefficients.

The coefficient of economic sustainability has the following mathematical record:

$$CS = \sqrt{1 - \frac{\sum(Y_t - \hat{Y}_t)^2}{\sum(Y_t - \bar{Y})^2}} \quad (2)$$

where:

CS is the coefficient of economic sustainability.

The higher the coefficient (closer to 1), the closer the process fluctuations are to a rectilinear function, and this indicates a more sustainable process. Similarly, low levels of correlation dependence indicate a fluctuation far from the rectilinear function, which is a manifestation of the unsustainability of the studied process.

Table 1

Interpretation of CS values

CS value	Interpretation
0.8 – 1.0	Very high sustainability
0.6 – 0.8	High sustainability
0.4 – 0.6	Average sustainability
0.2 – 0.4	Low sustainability
0.0 – 0.2	Absence of sustainability

Source: Nestorov, 2021.

Since the distribution of the main countries – trading partners is specific, the analysis should take into account and include their sustainability over time. Galabova and Nestorov (2018) suggest a specific coefficient – the Geographic Sustainability Rate (GSr) of export/import – to measure its sustainability. The mathematical record is expressed by the following formula:

$$GSr = \frac{\sum_{i=1}^5 C}{5m} \quad (3)$$

where:

GSr is Geographic Sustainability rate of export/import;

C – number of times the partner country has been on the top five places of the geographic structure by different periods;

m – number of studied periods.

“Its values change from 0 to 1. The lower the value, the lower the sustainability of the partner countries in export/import, in other words, the geographic structure is dynamic. On the contrary, the higher the value of the rate, the higher the geographic concentration – during a certain period, the partner countries remain for a longer time” (Galabova, Nestorov, 2018).

Interpretation of the GSr values is presented on Table 2.

Table 2

Interpretation of GSr values

GSr value	Interpretation
0.0 – 0.2	Highly dynamic geographic structure
0.2 – 0.4	Dynamic geographic structure
0.4 – 0.6	Balanced geographic structure
0.6 – 0.8	Sustainable geographic structure
0.8 – 1.0	Highly sustainable geographic structure

Source: Galabova, Nestorov, 2018.

As “an expression of the external sector of an economy, the foreign trade of goods is indicative of its openness, its participation in the international division of labour, its international trade specialization and competitiveness” (Marinov, 2017). That is why, when

analyzing such a topic, it is important to monitor the state and dynamics of the country's exports. Particularly the geographic structure, which shows the direction of trade relations, has an important place.

3. Analysis and Results

3.1 Wheat and meslin

Wheat is the most-grown cereal crop in Bulgaria. The main data for its production are presented on Table 3.

Table 3
Main indicators for the production of “Wheat” in Bulgaria in the period 2016-2020

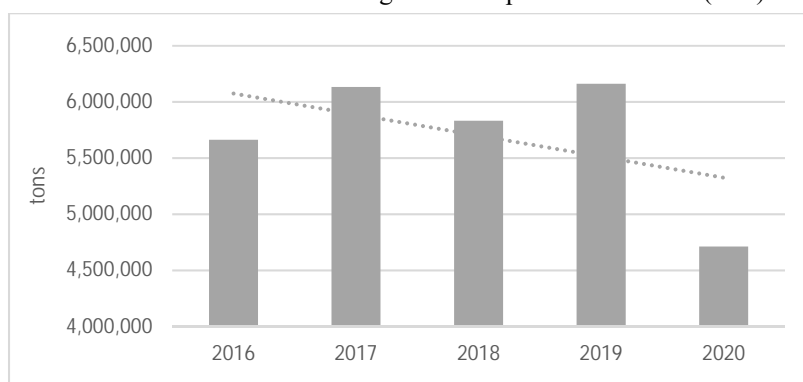
Wheat	2016	2017	2018	2019	2020
Harvested areas (ha)	1 192 589	1 144 519	1 212 012	1 198 682	1 200 175
Production (ton)	5 662 721	6 132 671	5 832 449	6 161 997	4 710 993
Average yields (ton per ha)	4.75	5.36	4.81	5.14	3.93

Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

About 1.2 million hectares of land are sown with “Wheat” each year. Production by years is presented on Figure 3.

Figure 3

Production of “Wheat” in Bulgaria in the period 2016-2020 (tons)



Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

Production of “Wheat” in Bulgaria in the period 2016-2020 varied from 4.71 to 6.16 million tons during the individual years of the studied period. The applied sustainability coefficient CS is 0.50, which indicates average sustainability of the process.

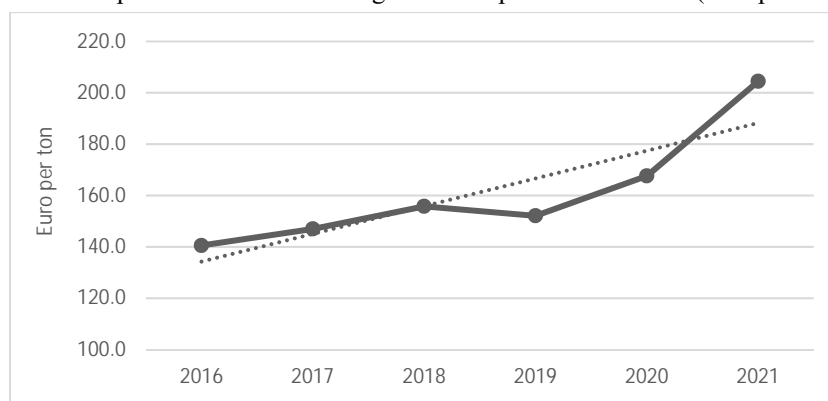
On the other hand, the average yield varies over the years between 3.93 and 5.36 tons per hectare of land. The yield was the highest in 2017, and the lowest in 2020. According to the Ministry of Agriculture, this is due to the bad impact of the main agrometeorological factors

on the development and yields of wheat in the country in 2020. Its sustainability for the period is 0.54 – average sustainability.

The data on the producer price of “Wheat” in Bulgaria in the period 2016-2021 are presented on Figure 4.

Figure 4

Producer price of “Wheat” in Bulgaria in the period 2016-2021 (euro per ton)



Source: according to NSI data.

Producer price increases during almost the entire period. In 2016 it was 140 euros and in 2015 it reached 295 euros. The coefficient of sustainability, in relation to the price, is 0.61. The value can be interpreted as very high sustainability.

By 2021 Bulgaria ranks 11th in the world in terms of “Wheat and meslin⁴” exports. Exports during the year reach 5 122 009 tons, forming a market share of 2.4% of the world trade.

By 2021 wheat ranks 2nd in Bulgaria’s export list. Its share during the entire period is about 3% of the country’s total commodity exports.

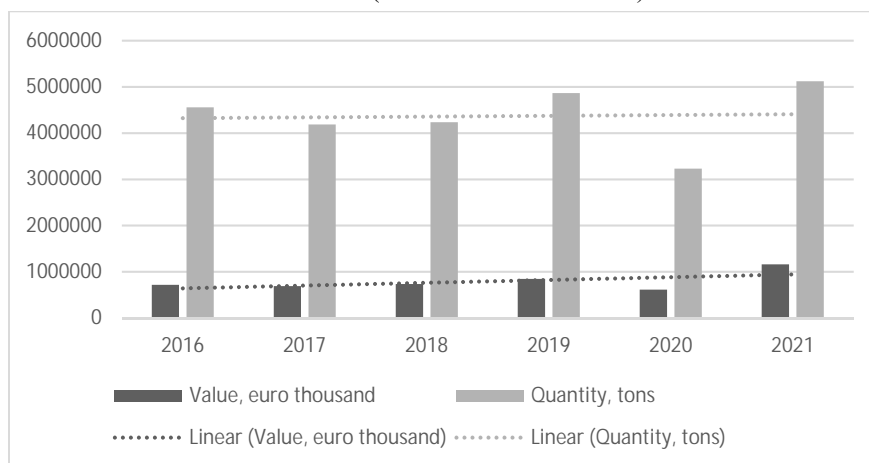
Exported quantities vary between 3 and 5 million tons per year. The coefficient of sustainability CS for the quantities is 0.05 – an absence of sustainability.

In the period 2016-2020, exports vary between 600 and 800 million euros. 2021 is an atypical year, when exports jump to over 116 million euros. The sustainability of the value is 0.58 – average sustainability.

The annual average unit value of one exported ton is presented on Figure 6.

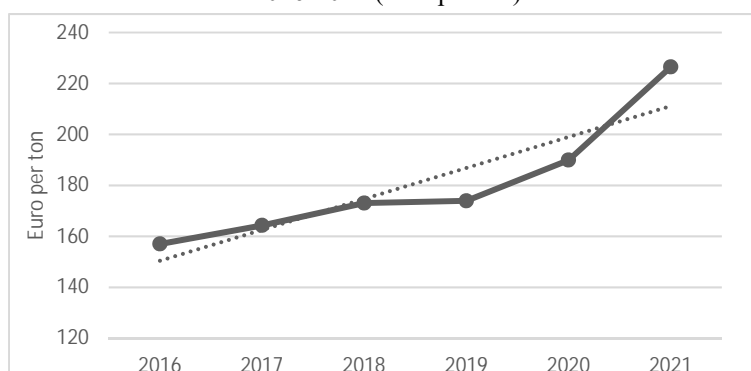
⁴ According to the Combined Nomenclature, wheat and meslin are grouped together under a 4-digit code. They are presented together in this section.

Figure 5
Quantities and values of the export of “Wheat and meslin” from Bulgaria in the period 2016-2021 (tons and thousand euros)



Source: according to data of International Trade Centre.

Figure 6
Annual average unit value of the export of “Wheat and meslin” from Bulgaria in the period 2016-2021 (euro per ton)



Source: own calculations with data of International Trade Centre.

The annual average unit value of one exported ton steadily increases during the studied period – from around 160 to over 220 euros per ton. The coefficient of sustainability is 0.91 – very high sustainability.

The geographic distribution of the export transactions is presented on Table 4.

The share of the top five partner countries in the export of wheat varies between 52 and 69% of all exports. This is an indicator of a concentrated geographic structure of exports. It can be considered a prerequisite for the influence of the economic situation of these countries on the Bulgarian economy (Tassev, 2012).

Table 4

Top five partner countries of Bulgaria in the export of “Wheat and meslin” in the period 2016-2021 and their annual relative shares

Rank in export	2016	2017	2018	2019	2020	2021
1	Spain 23	Spain 40	Spain 31	Spain 22	Spain 19	Spain 14
2	Italy 15	Greece 11	Italy 14	Greece 11	Greece 15	Greece 13
3	Romania 11	Italy 9	Romania 9	Romania 8	Romania 11	Romania 9
4	Greece 10	Romania 8	Greece 8	Philippines 7	Philippines 8	Tunisia 8
5	Vietnam 8	Libya 6	Germany 7	Italy 5	Libya 7	Korea 8
Total top 5	67%	74%	69%	53%	60%	52%

Source: own calculations with data of International Trade Centre

Concerning geographic sustainability, GSr is 0.77. This is the “sustainable geographic structure” of Wheat exports.

3.2. Sunflower seeds, whether or not broken

Sunflower is the second most grown crop in Bulgaria. The main data on its production are presented on Table 5.

Table 5

Main indicators for the production of “*Sunflower seeds*” in Bulgaria in the period 2016-2020

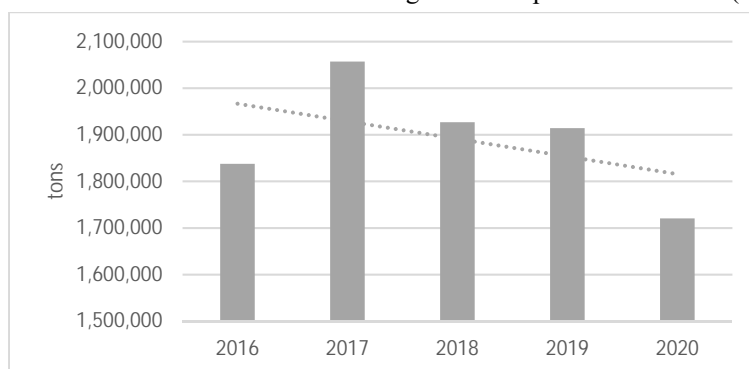
<i>Sunflower seeds</i>	2016	2017	2018	2019	2020
Harvested areas (ha)	817 511	898 844	788 656	815 561	821 922
Production (ton)	1 837 677	2 056 987	1 927 040	1 914 072	1 720 299
Average yields (ton per ha)	2.25	2.29	2.44	2.35	2.09

Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

About 830 000 hectares of land are sown with sunflower each year. Production by years is presented on Figure 7.

Figure 7

Production of “Sunflower seeds” in Bulgaria in the period 2016-2020 (tons)



Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

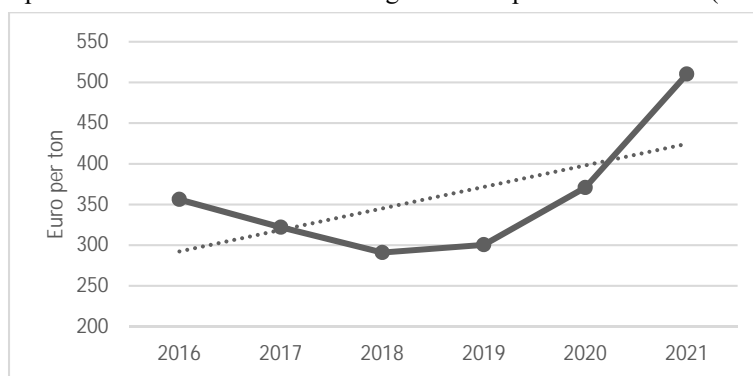
Production of Sunflower seeds in Bulgaria in the period 2016-2020 varies between 1.7 and 2 million tons during the individual years of the studied period. The applied coefficient of sustainability CS is 0.48, which indicates average sustainability of the process.

On the other hand, the average yield varies over the years between 2.09 and 2.44 tons per hectare of land. The yield is the highest in 2018, and the lowest in 2020. According to the Ministry of Agriculture, this is due to the bad impact of the main agrometeorological factors on the development and yields of sunflower in the country in 2020. Its sustainability for the period is 0.31 – low sustainability.

Data for producer price of “Sunflower seeds, whether or not broken” in Bulgaria in the period 2016-2021 are presented on Figure 8.

Figure 8

Producer price of “Sunflower seeds” in Bulgaria in the period 2016-2021 (euro per ton)



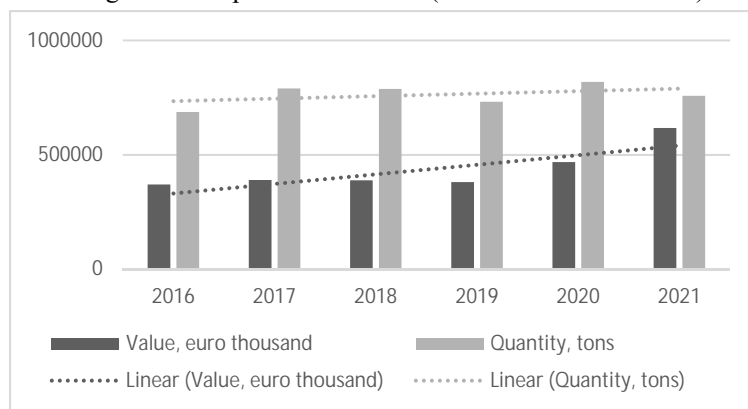
Source: according to NSI data.

Producer prices in the period up to 2018 dropped from nearly 360 to 290 euros per ton. Since 2019, the price has started to increase and reaches 500 euros per ton in 2021. The coefficient of sustainability, in relation to the price, is 0.61. The value can be interpreted as high sustainability.

By 2021 Bulgaria is on 2nd place in the world in the export of “Sunflower seeds, whether or not broken”. Exports during the year reach 757 451 tons, forming a market share of 15.4% of the world trade.

By 2021 Sunflower seeds is 2nd in Bulgaria’s export list. Its relative share during the entire period is about 1.5% of the country’s total commodity exports.

Figure 9
Quantities and values of the export of “Sunflower seeds, whether or not broken” from Bulgaria in the period 2016-2021 (tons and thousand euros)



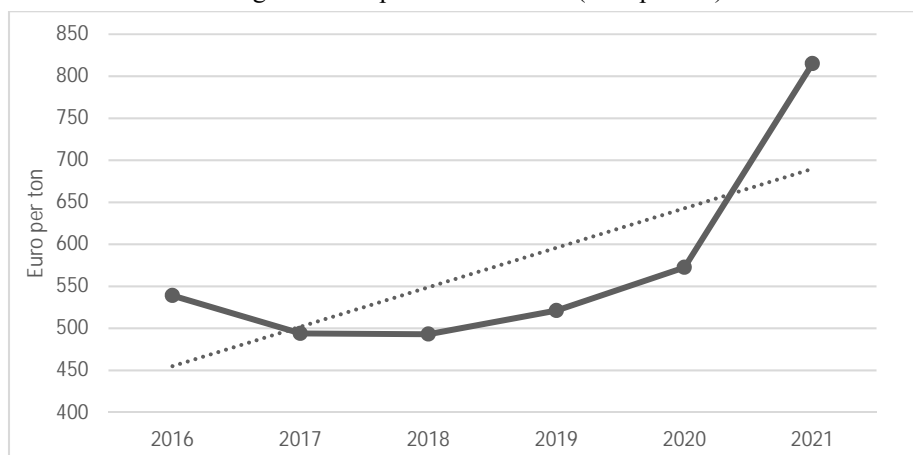
Source: according to data of International Trade Centre.

The exported quantities vary between 670 and 820 thousand tons per year. The coefficient of sustainability CS for the quantities is 0.43 – average sustainability.

In the period 2016-2019 exports vary between 370 and 390 million euros. In 2020 and 2021, exports increased to over 610 million euros. The sustainability of the value is 0.82 – very high sustainability.

The annual average unit value of one exported ton is presented on Figure 10.

Figure 10
Annual average unit value of the export of “Sunflower seeds, whether or not broken” from Bulgaria in the period 2016-2021 (euro per ton)



Source: own calculations according to data of International Trade Centre.

Annual average unit value of one exported ton drops till 2018. Since 2019 the price starts to increase and reaches over 800 euros per ton in 2021. The coefficient of sustainability, in relation to the price, is 0.72. The value can be interpreted as high sustainability.

The geographic distribution of the export transactions of sunflower from Bulgaria is presented on Table 6.

Table 6
Top five partner countries of Bulgaria in the export of “Sunflower seeds, whether or not broken” in the period 2016-2021 and their annual relative shares

Rank in export	2016	2017	2018	2019	2020	2021
1	Netherlands 17	Germany 16	Netherlands 26	Germany 16	Germany 15	Germany 14
2	Germany 16	Netherlands 14	Germany 15	Netherlands 13	Netherlands 15	Turkiye 14
3	France 9	Turkiye 12	UK 8	UK 9	USA 12	USA 9
4	UK 7	UK 8	Romania 7	USA 8	Turkiye 8	UK 9
5	Turkiye 6	France 6	Turkiye 6	Turkiye 8	UK 8	Netherlands 8
Total top 5	55%	56%	62%	54%	58%	54%

Source: own calculations with data from International Trade Centre.

The share of the top five partner countries in the export of Sunflower varies between 54 and 62% of the total export. This is an indicator of a balanced geographic structure of exports. It is a prerequisite for a high influence of the economic situation of these countries on the Bulgarian one.

Concerning the geographic sustainability, GSr is 0.90. This corresponds to a highly stable geographic structure.

3.3. Maize or corn

Maize or corn is the third most-grown cereal crop in Bulgaria. The main data on its production are presented on Table 7.

Table 7
Main indicators for the production of “**Maize**” in Bulgaria in the period 2016-2020

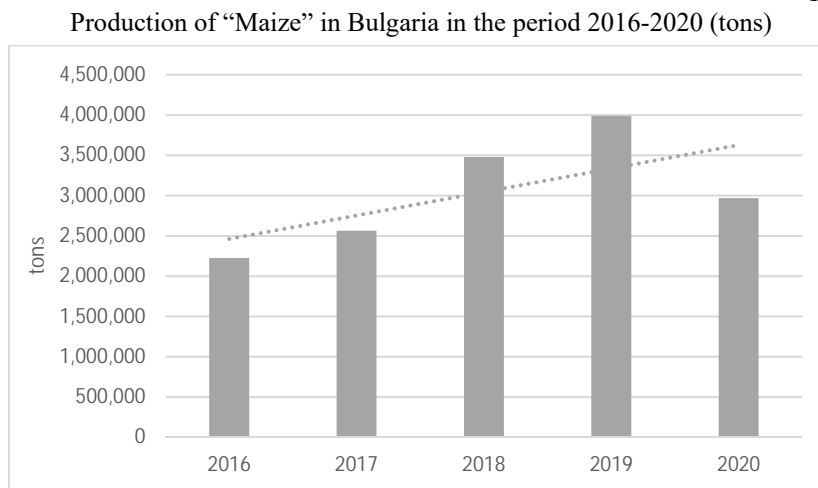
Maize	2016	2017	2018	2019	2020
Harvested areas (ha)	406 942	398 152	444 623	560 911	581 532
Production (ton)	2 226 094	2 562 569	3 478 013	3 990 190	2 969 210
Average yields (ton per ha)	5.47	6.44	7.82	7.11	5.11

Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

About 480 000 hectares of land are sown with “Maize” every year. Production by years is presented on Figure 11.

Production of “Maize” in Bulgaria in the period 2016-2020 varies between 2.2 and 4 million tons in the individual years of the studied period. The applied coefficient of sustainability CS is 0.65, which indicates high sustainability of the process.

Figure 11



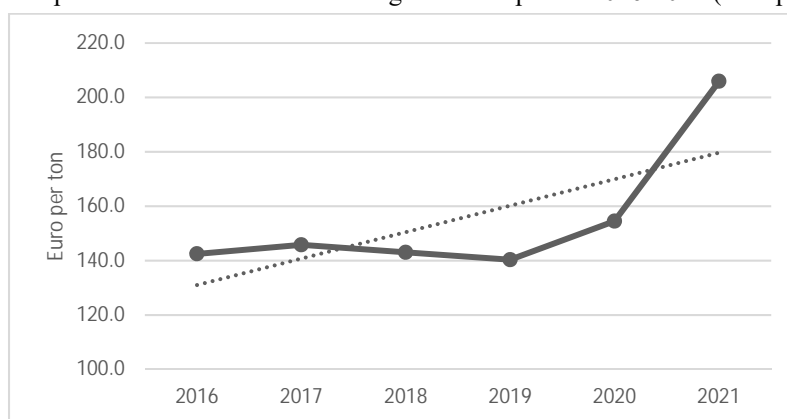
Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

On the other hand, the average yield varies over the years between 5.1 and 7.8 tons per hectare of land. The yield is the highest in 2018, and the lowest in 2020. According to the Ministry of Agriculture, this is due to the bad impact of the main agrometeorological factors on the development and yields of maize in the country in 2020. The coefficient CS in the period is 0.01 – an absence of sustainability.

The data on the producer price of “Maize or corn” in Bulgaria in the period 2016-2021 are presented on Figure 12.

Figure 12

Producer price of “Maize or corn” in Bulgaria in the period 2016-2021 (euro per ton)

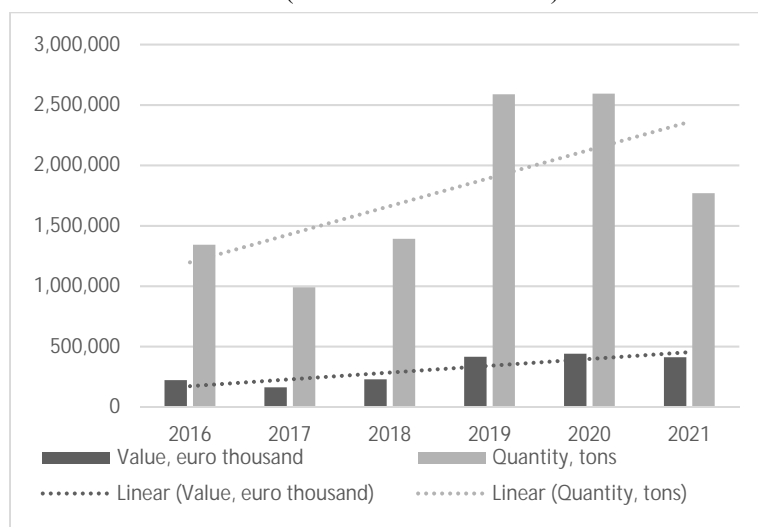


Source: according to NSI data.

Producer price in the period up to 2019 varies around 140 euros per ton. In 2020 and 2021, it increases, reaching over 200 euros per ton. The coefficient of sustainability, in relation to the price, is 0.72. The value can be interpreted as high sustainability.

Figure 13

Quantities and values of the export of “Maize or corn” from Bulgaria in the period 2016-2021 (tons and thousand euros)



Source: according to data of International Trade Centre.

By 2021 Bulgaria ranks 16th in the world in terms of “Maize or corn” exports. Exports during the year reach 1 769 736 tons, forming a market share of 1.3% of the world trade.

By 2021, Maize ranks 15th in Bulgaria’s export list. Its relative share during the entire period is about 1.1% of the country’s total commodity exports.

Exported quantities vary between 1 and 2.5 million tons per year. The coefficient of sustainability CS for the quantities is 0.64 – high sustainability of the process.

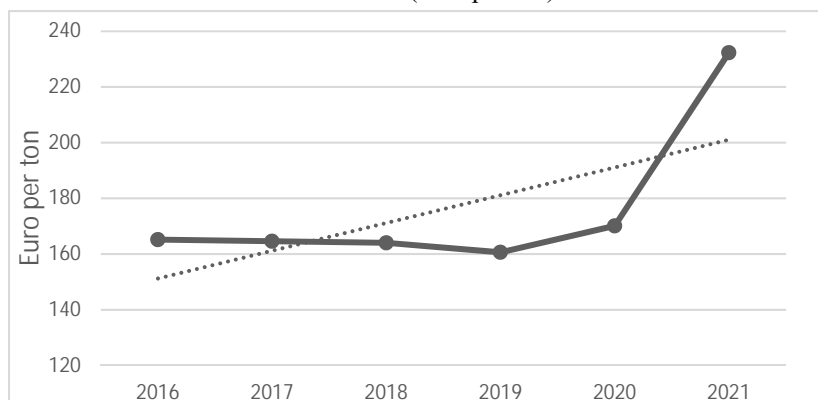
In the period 2016-2021, exports vary from 160 to 440 million euros. The sustainability of the value is 0.86 – very high sustainability.

Annual average unit value of one exported ton is presented on Figure 14.

Annual average unit value of one exported ton varies around 160 euros until 2019. Then it increases – from around 160 to over 230 euros per ton. The coefficient of sustainability is 0.67 – high sustainability.

Geographic distribution of the export transactions with Maize or corn in the period 2016-2021 is presented on Table 8.

Figure 14
Annual average unit value of the export of “Maize or corn” from Bulgaria in the period 2016-2021 (euro per ton)



Source: own calculations according to data of International Trade Centre.

Table 8
Top five partner countries of Bulgaria in the export of “Maize or corn” in the period 2016-2021 and their annual relative shares

Rank in export	2016	2017	2018	2019	2020	2021
1	Greece 16	Greece 29	Greece 32	Greece 25	Greece 20	Greece 23
2	Romania 14	France 13	Romania 20	Romania 17	Romania 15	Romania 19
3	Portugal 10	Netherlands 8	Korea 10	Spain 10	Iran 12	Spain 14
4	Spain 10	Spain 8	Italy 9	Turkiye 6	Netherlands 8	Korea 13
5	Italy 8	UK 7	Cyprus 4	Spain 5	Spain 8	China 10
Total top 5	58%	65%	75%	63%	63%	79%

Source: calculations with data of International Trade Centre.

The share of the leading five countries – trade partners in the export of Maize or corn varies between 63 and 79% of all exports. This is an indicator of a concentrated geographic structure of exports. Such a significant concentration is a prerequisite for a strong influence of the economic situation of these countries on the Bulgarian economy.

Concerning geographic sustainability, GSr is 0.63. This corresponds to a “sustainable geographic structure” of Maize or corn exports.

3.4 Rape or colza seeds, whether or not broken

Rape seed is the fifth most-grown crop in Bulgaria. The main data on its production are presented on Table 9.

Table 9

Main indicators for the production of “Rape” in Bulgaria in the period 2016-2020

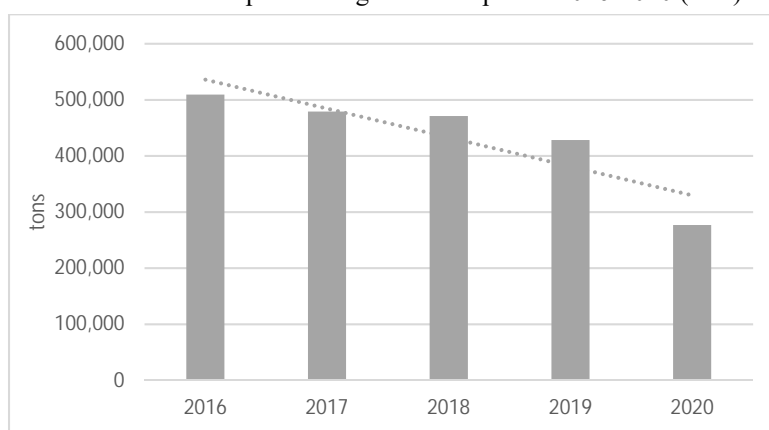
Rape	2016	2017	2018	2019	2020
Harvested areas (ha)	171 511	160 650	182 619	151 174	119 137
Production (ton)	509 251	478 987	471 035	428 256	276 846
Average yields (ton per ha)	2.97	2.98	2.58	2.83	2.32

Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

About 160 000 hectares of land are sown with “Rape” every year. Production by year is presented on Figure 15.

Figure 15

Production of “Rape” in Bulgaria in the period 2016-2020 (tons)



Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

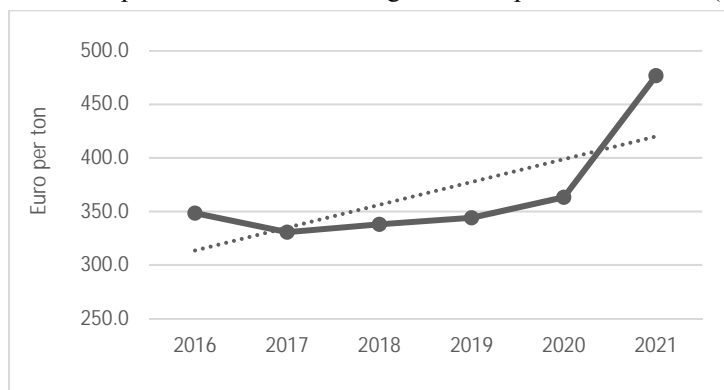
Production of “Rape” in Bulgaria in the period 2016-2020 varies between 277 and 509 thousand tons in the individual years of the studied period. The applied coefficient of sustainability CS is 0.89, which indicates the very high sustainability of the process.

On the other hand, the average yield varies over the years between 2.3 and 3 tons per hectare of land. The yield was the highest in 2017, and the lowest in 2020. According to the Ministry of Agriculture, this is due to the bad impact of the main agrometeorological factors on the development and yields of rapeseed in the country in 2020. Its sustainability for the period is high – 0.81.

Data on the producer price of “Rape or colza seeds” in Bulgaria in the period 2016-2021 are presented on Figure 16.

Producer price in the period till 2020 varies from around 350 euros per ton. In 2021, it increases and reaches over 470 euros per ton. The coefficient of sustainability in terms of price is 0.73. The value can be interpreted as high sustainability.

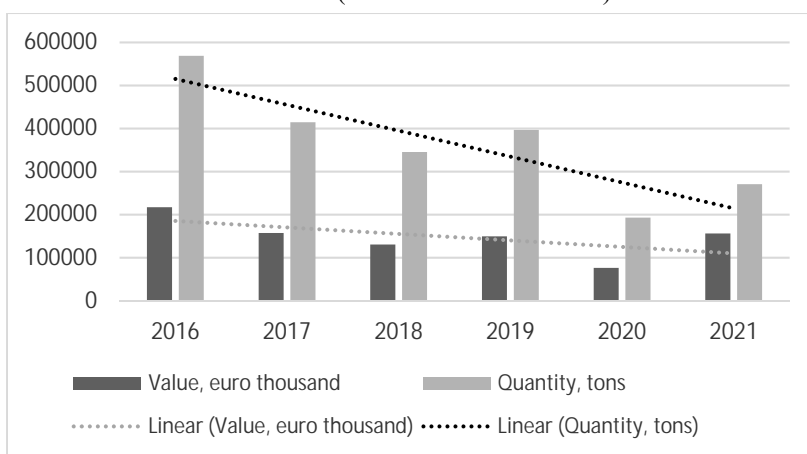
Figure 16
 Producer price of “Rape or colza seeds” in Bulgaria in the period 2016-2021 (euro per ton)



Source: according to NSI data.

By 2021 Bulgaria is 14th in the world in terms of export of “Rape or colza seeds”. Exports during the year reach 270 653 tons, forming a market share of 1.3% of the world trade.

Figure 17
 Quantities and values of the export of “Rape or colza seeds” from Bulgaria in the period 2016-2021 (tons and thousand euros)



Source: according to data of International Trade Centre.

By 2021 Rapeseed is on 56th place in Bulgaria’s export list. Its relative share during the entire period is about 0.5% of the country’s total commodity exports.

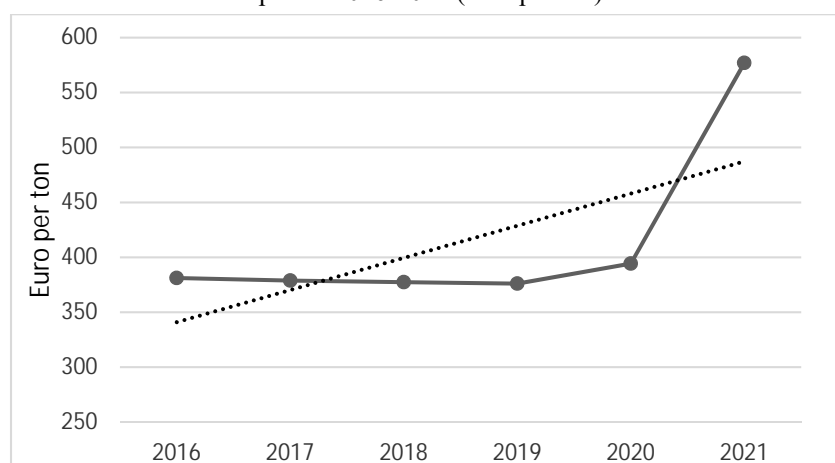
The exported quantities vary between 570 and 192 thousand tons per year. The coefficient of sustainability CS for the quantities is 0.87 – very high sustainability.

In the period 2016-2021 exports vary between 75 and 216 thousand euros. The coefficient CS is 0.62 – high sustainability.

Annual average unit value of one exported ton is presented on Figure 18.

Figure 18

Annual average unit value of the export of “Rape or colza seeds” from Bulgaria in the period 2016-2021 (euro per ton)



Source: own calculations with data of International Trade Centre.

Annual average unit value of one exported ton steadily increases in the studied period – from around 370 to over 580 euros per ton. The coefficient of sustainability is 0.68 – high sustainability.

The geographic distribution of the export transactions is presented on Table 10.

Table 10

Top five partner countries of Bulgaria in the export of “Rape or colza seeds” in the period 2016-2021 and their annual relative shares

Rank in export	2016	2017	2018	2019	2020	2021
1	Belgium 42	Belgium 46	Belgium 51	Netherlands 43	Netherlands 45	Netherlands 55
2	Germany 20	Netherlands 29	Netherlands 39	Belgium 36	Belgium 43	Belgium 17
3	France 13	France 12	Turkiye 5	Germany 14	Romania 9	France 11
4	Netherlands 10	Portugal 6	Romania 4	Romania 5	Greece 2	Portugal 7
5	Turkiye 8	South Africa 5	France 1	Greece 1	France 1	Hungary 4
Total top 5	93%	98%	100%	99%	100%	94%

Source: own calculations with data of International Trade Centre.

The share of the top five trading partner countries in the export of rape seed varies between 93 and 100% of all exports. This is an indicator of a highly concentrated geographic structure of exports. It is practically a prerequisite for a high influence of the economic situation of these countries on the Bulgarian economy. Zlatinov and Atanasov (2021) study the relationship between economic crises and convergence between countries.

Concerning geographic sustainability, GSr is 0.67. This corresponds to a “sustainable geographic structure” of exports.

3.5 Barley

Barley is the fourth most-grown cereal crop in Bulgaria. The main data on its production are presented on Table 11.

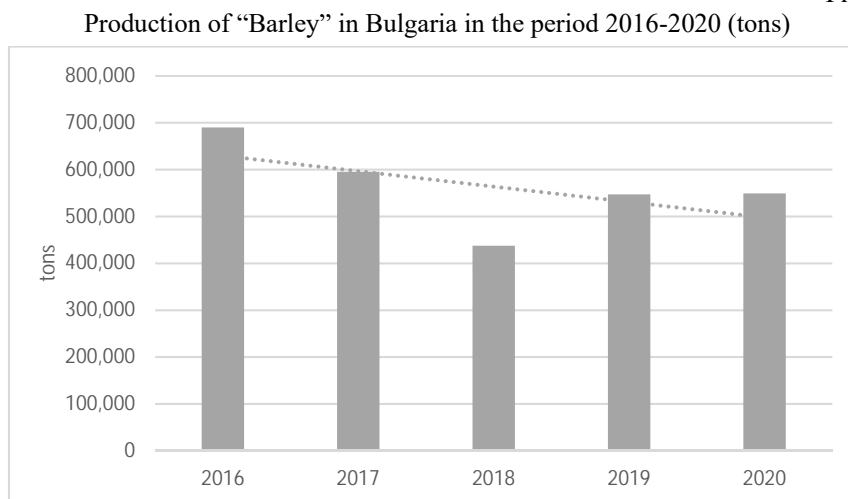
Table 11
Main indicators for the production of “**Barley**” in Bulgaria in the period 2016-2020

Barley	2016	2017	2018	2019	2020
Harvested areas (ha)	159 830	128 365	103 570	112 029	130 757
Production (ton)	689 850	595 237	437 507	547 244	549 079
Average yields (ton per ha)	4.3	4.6	4.2	4.9	4.2

Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

About 125 000 hectares of land are sown with “Barley” annual average for the period. Production by year is presented on Figure 19.

Figure 19



Source: Ministry of Agriculture, Food and Forestry – Department “Agrostatistics”.

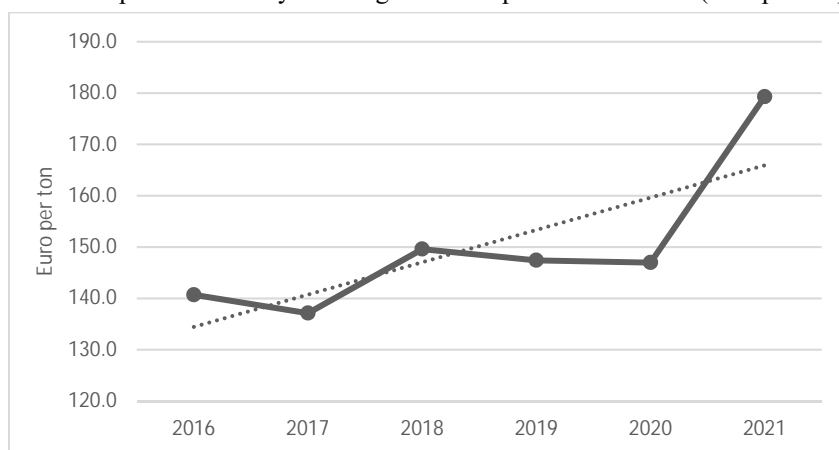
Production of “Barley” in Bulgaria in the period 2016-2020 varies between 437 and 690 thousand tons during the individual years of the studied period. The applied coefficient of sustainability CS is 0.57, which indicates average sustainability of the process.

On the other hand, the average yield varies over the years between 4.2 and 4.9 tons per hectare of land. The yield is the highest in 2019, and the lowest in 2018 and in 2020. According to the Ministry of Agriculture, this is due to the bad impact of the main agrometeorological factors on the development and yields of barley in the country in 2020. The coefficient CS is 0 – an absence of sustainability.

The data on the producer price of “Barley” in Bulgaria in the period 2016-2021 are presented on Figure 20.

Figure 20

Producer price of “Barley” in Bulgaria in the period 2016-2021 (euro per ton)



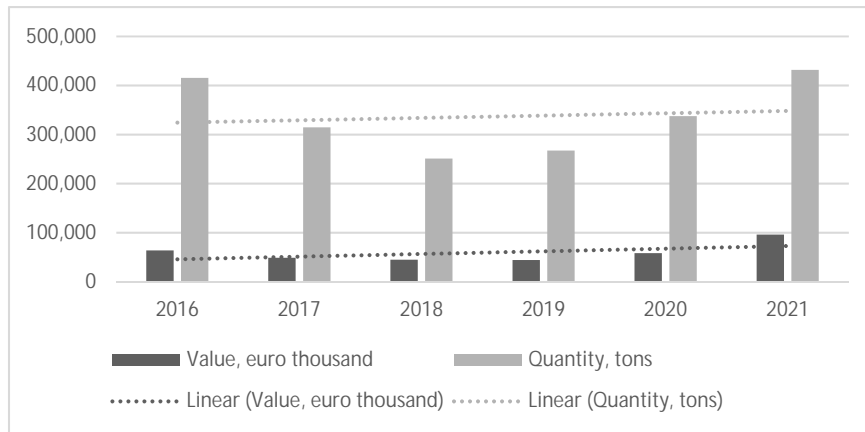
Source: according to NSI data.

Producer price in the period until 2020 varies between 137 and 150 euros per ton. Since 2021, the price marks a serious increase and reaches 180 euros per ton. The coefficient of sustainability, in relation to the price, is 0.78. The value can be interpreted as high sustainability.

By 2021, Bulgaria is 15th in the world in terms of exports of “Barley”. Exports during the year reach 431 761 tons, forming a market share of 1% of the world trade.

By 2021 Barley is 85th in Bulgaria’s export list. Its relative share during the entire period is about 0.2% of the country’s total commodity exports.

Figure 21
Quantities and values of the export of “Barley” from Bulgaria in the period 2016-2021
(tons and thousand euros)



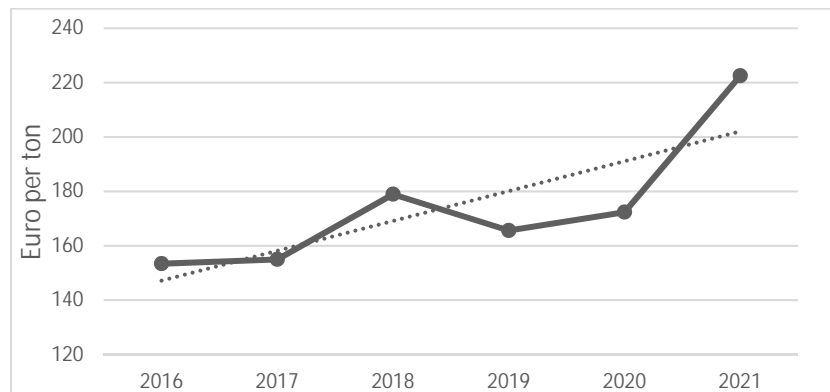
Source: according to data of International Trade Centre.

The exported quantities vary between 250 and 430 thousand tons per year. The coefficient of sustainability CS for the quantities is 0.12 – an absence of sustainability.

In the period 2016-2020, exports vary from 44 to 63 million euros. 2021 is an atypical year, when exports reach over 96 million euros. The coefficient of sustainability of the value is 0.52, corresponding to average sustainability.

Annual average unit value of one exported ton is presented on Figure 22.

Figure 22
Annual average unit value of the export of “Barley” from Bulgaria in the period 2016-2021
(euro per ton)



Source: own calculations with data of International Trade Centre.

Annual average unit value of one exported ton increases with slight fluctuations during the studied period – from around 150 to over 220 euros per ton. The coefficient CS has a value of 0.81 – high sustainability.

The geographic distribution of the export transactions is presented on Table 12.

Table 12

Top five partner countries of Bulgaria in exports of “Barley” in the period 2016-2021 and their annual relative shares

Rank in export	2016	2017	2018	2019	2020	2021
1	Libya 41	Spain 42	Libya 33	Saudi Arabia 24	Libya 30	Greece 30
2	Greece 26	Greece 28	Greece 20	Libya 23	Morocco 16	Spain 15
3	Spain 15	Libya 9	Tunisia 16	Greece 20	Tunisia 15	Cyprus 13
4	Cyprus 11	Cyprus 8	Algeria 10	Spain 12	Greece 15	Libya 13
5	Romania 2	Syrian Arab Republic 5	Turkiye 6	Israel 9	Romania 14	Israel 12
Total top 5	95%	92%	85%	88%	90%	83%

Source: own calculations with data of International Trade Centre.

The share of the top five partner countries in Barley exports varies between 83 and 95% of all exports. This is an indicator of a highly concentrated geographic structure of exports. A prerequisite has been formed for a high influence of the economic situation of these countries on the Bulgarian one.

Concerning geographic sustainability, the GSr coefficient is 0.63. This corresponds to a “sustainable geographical structure” of Barley exports.

4. Summary of the Results

The results of the study of the sustainability of the production and the export of the studied main cereals and oil crops are summarized on Table 13.

Table 13

Summary of the results of the study of the sustainability of the production and the export of main cereals and oil crops from Bulgaria

Summary on sustainability	Production	Average yield	Producer price	Exported quantities	Average price	Value of export	Geographic structure
Wheat and meslin	0.50	0.54	0.61	0.58	0.91	0.58	0.77
Sunflower seeds, whether or not broken	0.48	0.31	0.61	0.43	0.72	0.82	0.90
Maize or corn	0.65	0.01	0.72	0.64	0.67	0.86	0.63
Rape or colza seeds, whether or not broken	0.89	0.81	0.73	0.87	0.68	0.62	0.67
Barley	0.57	0.00	0.78	0.12	0.81	0.52	0.63

Source: own calculations.

For the studied period 2016-2021. for the established sustainability of the processes, it can be concluded that in terms of production and export of the main cereals and oil crops from Bulgaria:

- *The sustainability of the production* of main cereal and oil crops is generally high, with the highest sustainability for Rape or colza seeds (0.89) and the lowest for Sunflower seeds (0.48).
- Concerning *average yield*, the coefficient of sustainability varies within wider limits. The sustainability is highest for Rape or colza seeds (0.81), and lowest for Maize or corn (0.01) and Barley (0.00).
- Concerning *producer prices*, sustainability is observed across all crops, with the coefficient ranging from 0.61 to 0.78.
- Concerning *exported quantities*, the sustainability of Rape or colza seeds is highest (0.87), and the one of Barley is lowest (0.12).
- The analysis of the *average annual export prices* shows that all studied crops demonstrate sustainability. Wheat and meslin (0.91) and Barley (0.81) have the highest sustainability.
- High sustainability of the *export value* is demonstrated by Maize or corn (0.86), followed by Sunflower seeds (0.82). Barley has the lowest sustainability value (0.52).
- Concerning the *geographic structure*, all commodities show sustainability. Only Sunflower seeds show very high sustainability – 0.90.

As a whole, the highest sustainability on most indicators is observed for Rape or colza seeds, followed by Wheat and meslin, Sunflower seeds. Maize or corn and Barley have lower sustainability.

Conclusion

Agriculture continues to be one of the most dynamic sectors in Bulgaria. Provoked by many factors, farmers are constantly looking for ways to increase their yields or improve their production.

Based on the results presented here, namely that three of the five studied crops have high sustainability of the production and export processes, the following comments and recommendations can be made:

- Production of cereals and oil crops is sustainable and will continue to occupy a main part of the arable land in Bulgaria.
- Production is relatively sustainable and with improving competitiveness in the international market.
- The current sustainable functioning of the cereal and oil crops is also supported by the good potential for production growth based on the growth of average yields. More

sustainable yields for maize can be achieved by introducing irrigation practices and technologies, and according to experts, average yields can increase by at least 50%.

- The export of the five crops from Bulgaria will remain stable and in the medium term, a significant contribution is expected to the formation of a positive foreign trade balance from agricultural goods in Bulgaria.
- The main challenges in the short and medium term for Bulgarian grain producers are controlling the costs and increasing the yields, which is a strategy against price fluctuations.
- Direct payments in Bulgarian agriculture are an important buffer for meeting a drop in income in grain production. Apart from them, other risk management tools (production, technological and insurance) are not sufficiently widespread. This threatens these producers, both from unfavourable natural conditions (as it is in 2020 for three of the studied crops), and from price upheavals.
- Cereal and oilseed production should be considered a good opportunity for the development of new economic cycles and value chains (processing and energy, for example), as well as a basis for providing the necessary feed at competitive prices for animal husbandry.

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Annex I

List of codes of the main cereals according to the Combined Nomenclature

<i>Code</i>	<i>Name</i>
1001	Wheat and meslin
1206	Sunflower seeds, whether or not broken
1005	Maize or corn
1205	Rape or colza seeds, whether or not broken
1003	Barley