Agro-Ecological Conditions and Regional Features in the Production of Wheat and Sunflower

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Citation: Mikova, R. (2020). Agro-Ecological Conditions and Regional Features in the Production of Wheat and Sunflower. *Ikonomika i upravlenie na selskoto stopanstvo,* 65(4), 50-57 (Bg).

Abstract

A description of the soil and climatic conditions in Bulgaria and the suitability of agricultural lands for growing wheat and sunflower is made. The territorial distribution of the agro-ecological potential of the agricultural lands in 50 agro-ecological regions is used, grouped in seven by characteristic groups, which bear the names of the main soil types: chernozems; gray-brown forest soils; gray-brown pseudo-podzolic forest soils; resins and cinnamon forest soils; brown forest soils and mountain-meadow soils. Based on the assessments of the quality from the agro-ecological regions, quality cards have been created for the suitability of the agricultural lands in Bulgaria for growing wheat and sunflower. An analysis of the state and trends in the change in the final production, area, average yield, production of the studied agricultural culture in Bulgaria for the period 2007-2017 is made.

Key words: wheat; sunflower; agro-ecological regions; bonitet assessment; final production; average yield; area

Агроекологични условия и регионални особености при производството на пшеница и слънчоглед

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Резюме

Направено е описание на почвено-климатичните условия в България и пригодността на земеделските земи за отглеждане на пшеница и слънчоглед. Използвано е териториалното разпределение на агроекологичния потенциал на земеделските земи в 50 агроекологични райони, групирани в седем по-характерни групи, които носят имената на основните почвени типове: черноземи; сиво-кафяви горски почви; сиво-кафяви псевдоподзолисти горски почви; смоли и канелени горски почви; кафяви горски почви и планинско-ливадни почви. Въз основа на бонитетните оценки по агроекологичните райони са създадени бонитетни карти за пригодност на земеделските земи в България за отглеждане на пшеница и слънчоглед. Направен е анализ на състоянието и тенденциите в изменението на крайната продукция, площ, средния добив, производството на изследваните земеделски култури в България за периода 2007–2017 г.

Ключови думи: пшеница; слънчоглед; агроекологични райони; бонитетна оценка; крайна продукция; среден добив; площ

Introduction

The development of agrarian science shows that the study of the territory of the country separately as climatic and soil areas is not enough for the needs of agriculture. That is why their combined interpretation is already required as "agro-ecological complexes" – according to the requirements of the agricultural plants represented in our production (Valev, Georgiev, 2004). Agro-ecology is an applied part of the general ecology, which allows to concretize the study of agro-ecosystems despite their extreme complexity and therefore is very important for the development of modern agriculture (Hershkovich, 1970; 1984).

With the help of databases for agro-climatic and soil characteristics on the territory of Bulgaria the agricultural lands suitable for growing wheat and sunflower in conditions without irrigation have been determined. A bonitet assessment of agri-environmental conditions was used. Bonitet – PBC (Polish bonitet number) gives an idea of the suitability of the land in a particular area for growing a culture or group of culture. The bonitet ratings under non-irrigated conditions have values from 0 to 100 points, as the minimum rating is 0 points and the maximum rating is 100 points (Georgiev, 2006; Petrov et al., 1988; Krasteva, 2011; Krasteva et al., 2013). When the values are in the lower part of the scale, the conditions for growing the culture in the defined site are unsuitable and vice versa, when the values are in the upper part of the scale, the conditions for the culture are appropriate. The bonitet ball is the result of assessment of the physico-chemical (mechanical composition of arable land and subsoil, power of humus horizon, power of soil profile, pH, humus content in the surface horizon, groundwater level) indicators of soils, taking into account and the influence of erosion, accumulation, stoniness, swampiness, salinity. The climatic conditions in the region are assessed according to the requirements of wheat and sunflower and are rated 100 points for this indicator.

Wheat and sunflower are the main cultures in Bulgarian agriculture. In Bulgaria, wheat is grown on an area between 10 and 12 million dка, and sunflower on 6–7 million dка. Favorable soil and climatic conditions, rich traditions and experience have turned these crops into a measure of the possibilities of Bulgarian agricultural production. The conditions under which wheat and sunflower are grown are very different in different regions, which cause significant variation in the level and stability of yields and grain quality. The most favorable conditions for growing wheat are in Dobrudja, followed by the other plain regions of Northern Bulgaria.

The purpose of the report is on the basis of established working databases for agro-climatic and soil characteristics in Bulgaria to determine the spatial areas by degrees of suitability for growing wheat and sunflower in conditions without irrigation. The results of the study are presented in the form of maps in a GIS environment.

Materials and methods

Soil requirements

The most suitable soils for growing wheat and sunflower are the chernozems in Northern Bulgaria, which in some areas are in a complex with the gray forest soils. Their most common subtypes are carbonate, typical, leached and podzolic chernozems.

Heavy clay leached chernozems in Northwestern Bulgaria are not suitable for obtaining high yields of wheat and sunflower due to the deteriorating water regime in years with heavy rainfall.

Gray and light gray forest soils are not suitable for wheat and sunflower due to their heavy mechanical composition and acid reaction.

Chernozem-resins in Southern and Southwestern Bulgaria and especially leached smolnitsi due to their high moisture content favor the formation of a good harvest and high quality grain and seeds during years with prolonged droughts.

Cinnamon soils are generally suitable for agriculture provided they are provided with sufficient nutrients. To a large extent this also applies to cinnamon-podzolic forest soils.

The soil types distributed in the semi-mountainous areas are unsuitable for a normal harvest of wheat and sunflower.

Climate requirements

According to the amount of precipitation, Bulgaria belongs to the zone with unstable humidification. The climate is characterized by different droughts, frequency, duration and intensity of droughts, which occur during all four seasons and cover the most fertile regions of the country. Droughts are more frequent and prolonged during the period August–September, and in the beginning of summer the periods without precipitation are shorter and shorter (lasting more than 10 days). Droughts occur mainly in late summer and early autumn. In most areas the shortest periods are without precipitation in June and May, and the longest in September and August.

Due to the fact that the transitional-continental climate of the country determines the occurrence of frequent and significant droughts during the vegetation of wheat and sunflower, which usually have a negative impact on the yield of these crops, it is imperative to use such varieties of hybrids and to such technologies are applied in their cultivation, which would favor the manifestation of their genetically determined possibilities for good yield.

The natural and climatic conditions of Bulgaria are not an insurmountable barrier for the further increase of the production of wheat and sunflower. The listed features and requirements of wheat and sunflower must be well known in order to best adapt their cultivation to the given climatic conditions, soil diversity and location.

Methods used

For the purposes of the study, the condition and dynamics in the size of the areas, average yields and production of wheat and sunflower were analyzed.

In compiling the present methodology, the map of the agro-ecological regions in Bulgaria was used, compiled on the basis of summarized soil and climatic information in M 1: 600 000 (Yolevski et al., 1980). Bulgaria's land resources are divided into 50 agro-ecological regions, 40 of which cover the agricultural land fund. The agro-ecological regions are divided into 7 groups (Fig. 1.):

First group – the chernozems. Included are 11 regions of the northern hilly part of the Danube plain and northeastern Bulgaria. According to an overall bonitet rating, they are good to very good, occupy 23,000,000 decares and are suitable for growing wheat and sunflower.

Second group – on gray-brown forest soils. This includes 8 regions, located south of the first group, in the foothills of Northern Bulgaria. According to the bonitet rating, these areas are medium to good. They occupy about 18,000,000 decares and are suitable for growing the studied crops.

Third group – on gray-brown forest soils. The group includes three regions that occupy territories in the lower mountainous part of the Fore-Balkans and the northern slopes of Stara Planina. According to the overall bonitet rating, they are poor to medium. They cover an area of 6,000,000 decares and are generally suitable for wheat and sunflower only if the necessary nutrients and moisture are provided.

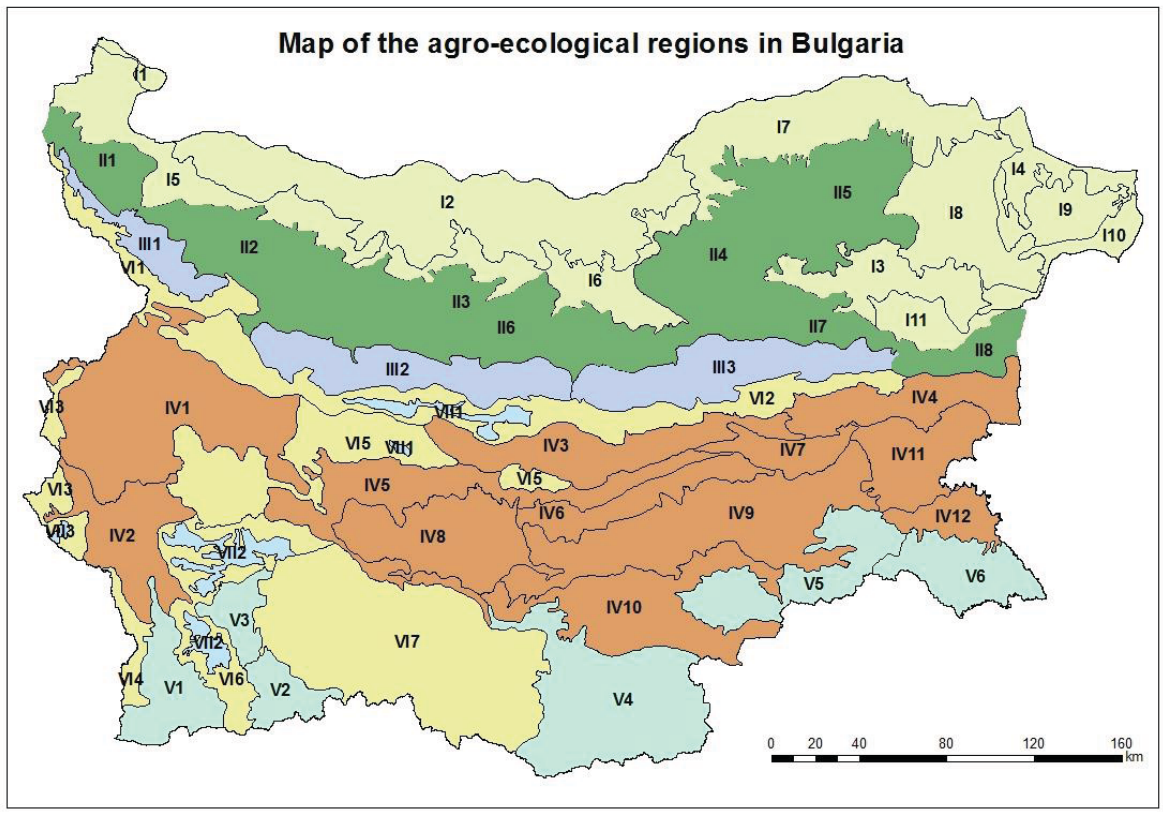
Fourth group – of resins and cinnamon forest soils, which cover 12 regions and most of Southern Bulgaria. According to the overall bonitet rating, these areas are good, as the variation in this respect is significant and wheat and sunflower can be successfully grown on them.

The other 3 agro-ecological areas (of the cinnamon forest soils, of the brown mountain forest soils and of the mountain-meadow soils) are unsuitable for growing wheat and sunflower.

Results and discussion

The bonitet assessment of wheat and sunflower are summarized in bonitet groups. Based on them, areas of "very good lands", "good lands", "average good lands", "bad lands" and "unsuitable lands" are distinguished. The results of the bonitet assessment are presented in the form of maps using the methods of Geographic Information Systems (Fig. 1 and Fig. 2). The location of the lands according to the suitability for the studied crops is presented.

Areas of 1,668,580 ha are estimated as "**very good lands**" with a bonitet assessments of 80–100 for wheat cultivation, and for sunflower 503 010 dка. To this group suitable for growing wheat and sunflower are the lands with carbonate and



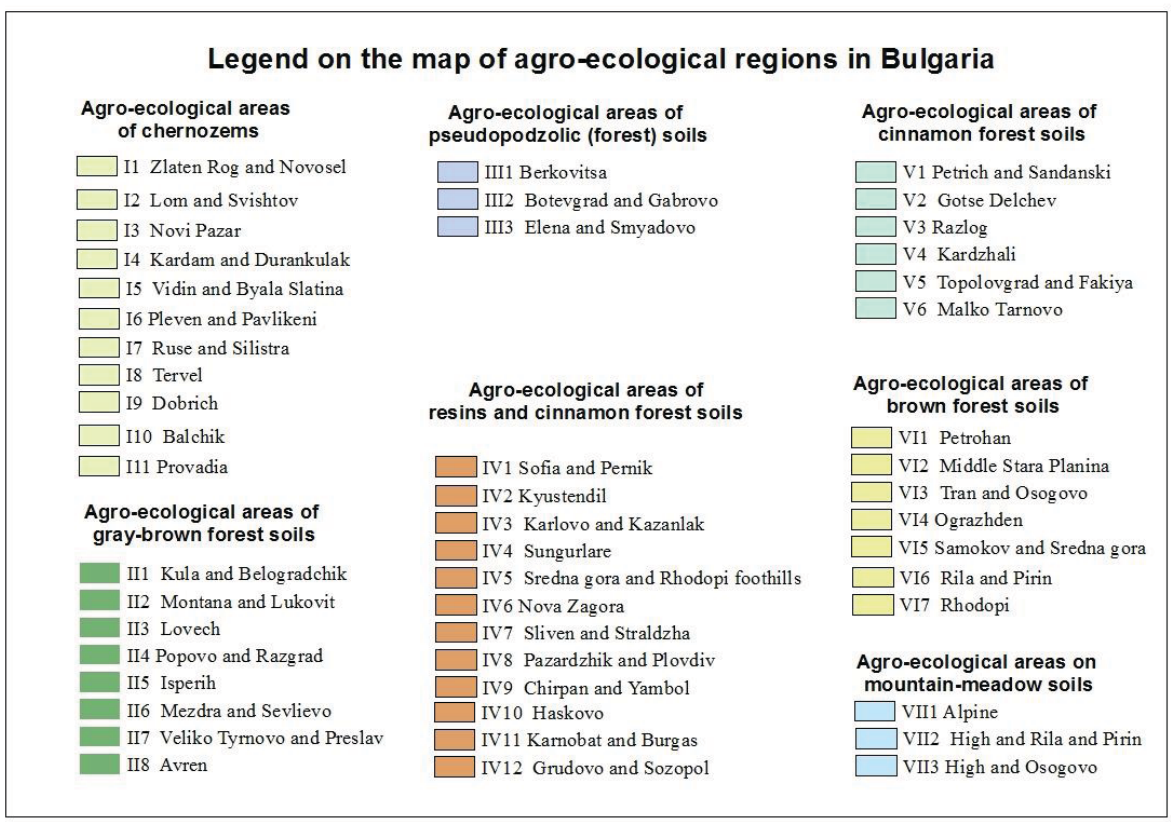


Fig. 1. Map of the agro-ecological regions in the People's Republic of Bulgaria

leached chernozems. In Northern Bulgaria the agricultural lands from the first quality group "very good lands" prevail, where the most areas with wheat are sown in the country (about 64.4%), and sunflowers in Vidin and Byala Slatina, Pleven and Pavlikeni and Tervel agro-ecological regions.

Rated as **"good land"** for wheat with a bonitet assessments of 60–80 are 2,511,940 ha, or 35.7% of the total land area, and for sunflower with 1,595,370 dka. These are lands with gray forest and leached cinnamon forest soils and located in the Upper Thracian lowlands, the Fore-Balkans, the eastern lowland part of the Balkan Mountains, the Burgas lowlands, Kraishte and others.

As unsuitable for growing wheat and sunflower are **"bad lands"** and **"unsuitable lands"** with a bonitet assessments of 20–40 and 0–20 ball and occupy 36.1% of the total land area in Bulgaria. This group includes lands with mountain-meadow soils, which are distributed in all mid-mountain areas of the country over 750–800–900 m to 1500 m altitude. These soils are unsuitable for agricultural use and the overall productive capacity of their lands is low.

Status and trends in the cultivation of wheat and sunflower

Wheat is a general culture in Bulgarian agriculture. The fluctuations in the harvested areas with wheat for the period 2007–2017 are relatively small – from 10879959 dka to 11445190 dka, which is a total growth of 4.9%.

The relative share of wheat in the total harvested areas with cereals in 2017 is 64%. The largest share of the harvested areas with wheat is occupied by the Northeast region – 24%, followed by the Northwest – 21.4% and the Southeast – 21.2%.

The total wheat production in the country in 2017 amounted to 6132671 tons, which is 156.5% above the level of 2007. The increase is mainly due to the higher average yield by 143.9% (535.8 kg/dka) under the influence of favorable climatic conditions in the process of culture development.

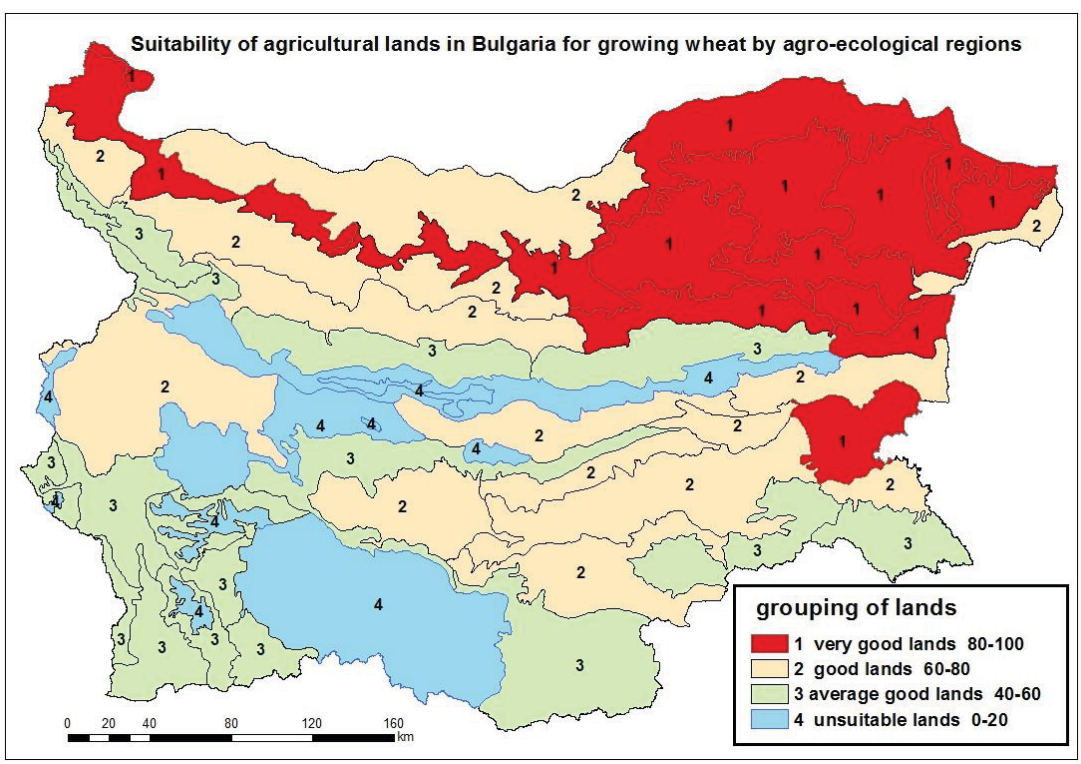


Fig. 2. Bonitet card for suitability of agricultural lands in Bulgaria for growing wheat by agro-ecological regions

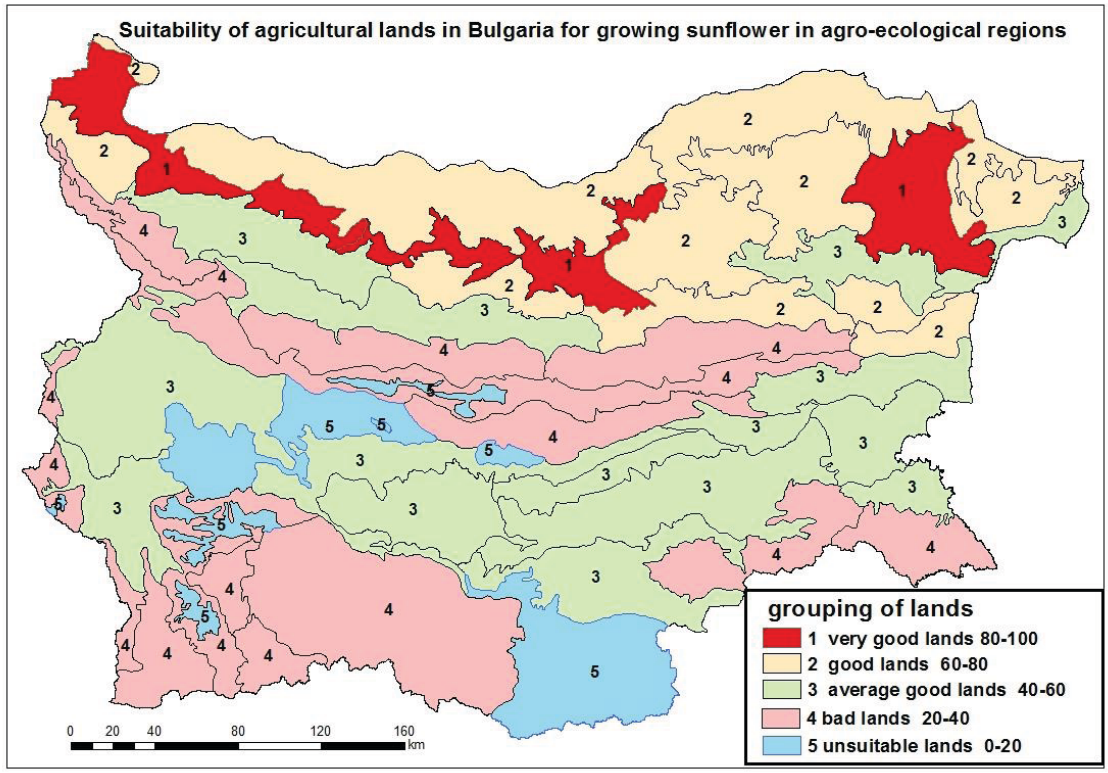


Fig. 3. Bonitet card for suitability of agricultural lands in Bulgaria for sunflower cultivation by agro-ecological regions

Table 1. Change in the areas, average yield and production of wheat and sunflower for the period 2007–2017

Culture	Harvested areas (dka)			Average yield (kg/dka)			Production (tons)		
	2007	2012	2017	2007	2012	2017	2007	2012	2017
Wheat	10879959	11850068	11445190	219.7	376.0	535.8	2390610	4455104	6132671
Sunflower	6023976	7807554	8988440	93.7	177.7	228.8	564447	1387780	2056987

Source: MAF, Directorate Agrostatistics, 2007–2017.

From the group of oilseeds, sunflower is the main raw material for oil production in the country. The harvested areas in 2017 amounted to 8,988,440 decares, 49.2% more than in 2007. Most areas with sunflower in 2017 are located in the North-West region – 2,264,450 dka or 25.2% of the harvested areas in the country. It is followed by the Northeast region with 2,044,500 dka (22.7%). Third is the North Central region with 1,798,800 dka (20.0%). The largest share of areas with sunflower, located on the predecessor wheat – 65.1%. No culture rotation was carried out on 4% of the areas.

There is a lasting positive trend in the average yields of sunflower, without significant deviations for the studied period 2007–2017. The high yields per unit area are reflected in the increased production of sunflower (Table 1). In the second decade of the twentieth century there was a tendency not only to increase the sown area with this oil crop, but also the average yields, which led to a marked increase in sunflower production. Sunflower production increased from 564,447 tonnes in 2007 to 2,056,987 in 2017.

The reason for the higher level of average yields and production of wheat and sunflower is

the observance of technological discipline. The main factors are: selection of hybrids suitable for the region, such as grain yield, oil content, resistance or tolerance to the most important diseases; correct crop rotation; suitable precursors; quality tillage; manuring; weed control diseases and pests.

Value of final production

In 2017, the value of final output from agriculture after deducting domestic turnover at basic prices, which also includes subsidies on products, amounted to BGN 8.239 billion, which is 5.2% (409.5 million BGN) more compared to 2016.

Traditionally, the revenues from plant growing are the highest and make up 67.6% of the total value of the produced production. For 2017, the relative share of livestock production is only 24.0%, agricultural services – 5.6% and the production of inseparable non-agricultural secondary activities – 2.8%.

Cereals and oilseeds remain with the largest share in the value of the final output of the industry. The two groups of culture together (respectively cereals worth BGN 2,437.8 million and oilseeds – BGN 1,489.9 million) form about half (47.7%) of the value of production in agriculture in 2017.

The largest contribution to the formation of the final production of the industry in 2017 have soft wheat – a share of 18.7%, by BGN 1,538.2 million and sunflower – a share of 14.1%, by 1,161.7 million BGN.

In the case of sunflower, the physical volume increased by 14.1% and at the same time decreased by 16.2% in prices, which determined the decrease in the value of production by 4.4% compared to the previous year.

Conclusion

The analysis of the condition and trends in the cultivation of wheat and sunflower shows that for the studied period 2007–2017 the average yield and production increased steadily after Bulgaria's accession to the EU.

The soil and climatic conditions in Bulgaria are analyzed. The developed bonitet maps for the suitability of the lands for growing wheat and sunflower give a visual idea of the possibilities for zoning of the crops. Maps for use by farmers, as they clearly show the location of "very good land", "good land", "medium land", "bad land" and "unsuitable land" for growing wheat and sunflower.

The greatest interest for agricultural producers is the areas occupied by "very good lands" and "good lands" for growing the studied crops.

Knowledge of the individual areas provides an opportunity to optimize and reduce the cost of fertilizers and preparations for growing wheat and sunflower. This guarantees higher yields as well as greater crop rotation efficiency.

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Table 2. Value of final wheat and sunflower production (million BGN) for the period 2016–2017

Culture	2016	Change – 2017/2016	2017
Soft wheat	1 433.5	7.3%	1 538.2
Sunflower	1 214.9	-4.4%	1 161.7

Source: MAF, Agricultural report 2019.

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