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Territorial Prospects for Growing Lentils

A K Mamakhai¹, M G Zagoruiko¹

¹Federal Scientific Agroengineering Center VIM

E-mail: mamakhaeva@mail.ru

Abstract. We assessed the prospects of lentil cultivation in the Russian Federation and the most favorable regions for this. The following tasks were set: we assessed the importance of lentils in the country's economy, identified promising regions for growing lentils, taking into account agronomic and economic conditions. When analyzing suitable regions for lentil cultivation, not only the agrotechnical conditions of cultivation were taken into account, but also economic factors, for example, the proximity and volume of sales markets, including exports. The selection of promising regions for growing lentils was made on the basis of its agrobiological properties, existing cultivation volumes and agro-climatic conditions of the regions of the Russian Federation. The impact of global climate change and the dynamics of lentil cultivation volumes in recent years were taken into account. Canada, as one of the world leaders in growing lentils, is located at the same latitude with the regions of the Saratov and Volgograd regions. In Russia, the Saratov and Volgograd regions are in good soil and climatic conditions for growing lentils. The high gross harvest was the result of an increase in the acreage under lentils, the value of which in 2019 amounted to 274 thousand hectares, which is 3 thousand hectares more than last year. The production of lentils is going on with a noticeable increase, which is due to the significant orientation of the cultivation of this crop for export. According to the AB-center, in 2015, export deliveries of lentils amounted to 7.4 thousand tons; in 2016-17.2; in 2017-64.6 thousand tons, 2018-77.9 thousand tons; 2019 – 79.8 thousand tons. In the course of research, it was found out that lentils play an important role in the national economy of the country. It is determined that the regions of the Saratov and Volgograd regions are the most promising for expanding lentil production both in terms of agro-climatic conditions and economic potential.

1. Introduction

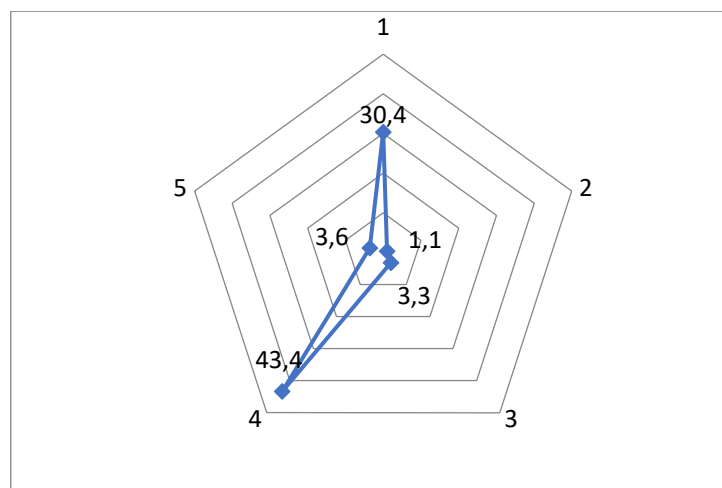
In Russia in the Middle Ages, lentil dishes were an indispensable part of the main diet. In addition, lentils were part of the diet of many Asian, North African, European, and American dishes, they were modest and inconspicuous everywhere. Recently, this culture has become exotic. With the advent of new food products, the dominant role of lentil dishes in the diet has receded into the background. However, the issue of fortification of food products with legumes occupies an important place and is relevant. A special place among legumes is occupied by lentils.

Lentils (*Lens culinaris* Medic.) is a valuable food crop, belongs to the legume family and is part of the group of leguminous crops, are widely used in the food industry and feed production. This is an annual herbaceous plant, rich in a source of high-quality protein, is a culture of diverse use.

In terms of protein content, the digestibility of seeds, lentils surpass most legumes. The composition is characterized by a high content of trace elements such as calcium, potassium, phosphorus, iron. It also contains manganese, copper, molybdenum, boron, iodine, cobalt, zinc, fatty



acids from the Omega-3 and Omega-6 groups. The lysine content in lentil proteins is similar to that of animals and this indicator is 2-2.5 times higher than that of cereals. In addition, it is a good source of B vitamins, contains vitamins PP, A, and when sprouting lentil grains, vitamin C increases significantly [1].



1-crude protein; 2-fat; 3-ash; 4-starch; 5-fiber

Figure 1. The content of the main components of the chemical composition of lentils, %.

It is noted that lentils do not accumulate toxic elements, radionuclides and can be considered an environmentally friendly product, and the protein of this culture in its nutritional value and saturation with essential amino acids, including lecithin, is in no way inferior to the protein contained in animal products.

The purpose of the study. To assess the prospects of lentil cultivation in the Russian Federation and the most favorable regions for this.

Tasks: to assess the importance of lentils in the country's economy, to determine promising regions for growing lentils, taking into account agronomic and economic conditions.

When analyzing suitable regions for lentil cultivation, not only the agrotechnical conditions of cultivation were taken into account, but also economic factors, for example, the proximity and volume of sales markets, including exports.

Research material and methodology

Given the important role of lentils in providing the population with valuable plant protein, it is necessary to further expand its acreage in the most successful regions for its cultivation. To date, the leader in the gross harvest of lentils is the Volga Federal District. Over the past decade, the Siberian Federal District has shown activity in growing this crop and rightfully took the second place. There is also an interest in the production of lentils in the Southern Federal District.

The production of lentils is going on with a noticeable increase, which is due to the significant orientation of the cultivation of this crop for export [2]. According to the specialists of the AB-center, in 2015, export deliveries of lentils amounted to 7.4 thousand tons; in 2016-17.2; in 2017-64.6 thousand tons, 2018-77.9 thousand tons; 2019 – 79.8 thousand tons.

According to the results of 2019-2020, a further increase in the volume of exports is expected, since sales will take into account the passing, produced and unsold volumes of previous years. In general, over a ten-year period, the volume of the Russian lentil market expanded 6.1 times [3].

In 2019-2020, farmers increased the production of lentils by 19%. The high gross harvest was the result of an increase in the acreage under lentils, the value of which in 2019 amounted to 274 thousand hectares, which is 3 thousand hectares more than last year [4]. Lentils are grown mainly in the central regions of the Volga region, most of them are in the Saratov region. It is also cultivated in the Penza,

Volgograd and other regions of the Volga region. In turn, these regions demonstrated record values for lentil harvesting in the reporting period of 2019 (Table) [5].

Table 1. Lentil production regions in 2017-2019.

Region	2017	2018	2019	2019 to 2017 %
The size of the sown area, thousand hectares				
Saratov region	36,8	81,1	40,0	108,69
Altai Territory	66,6	80,3	49,4	74,17
Penza region	9,1	16,1	6,1	14,91
Volgograd region	2,0	11,6	3,1	15,5
Gross harvest, thousand tons				
Saratov region	65,3	45,7	29,4	22,21
Altai Territory	64,6	73,2	41,8	15,45
Penza region	12,0	11,0	5,3	22,64
Volgograd region	3,0	7,2	2,1	14,28
Yield, c / ha				
Saratov region	17,9	6,1	8,2	21,83
Altai Territory	10,1	9,6	8,6	11,74
Penza region	13,5	7,8	9,3	14,51
Volgograd region	15,2	6,5	6,6	23,03

Among the regions of our country, the largest in terms of gross lentil harvest are: Altai Krai, Saratov, Volgograd, Samara, Rostov, Orenburg and Novosibirsk regions. They account for 95% of the total gross lentil harvest in Russia.

The volume of export supplies of Russian lentils to the world market has increased almost 10 times over the four-year period. According to the study "The lentil market in Russia and the world: research and forecast until 2023", prepared by the marketing agency ROIF Expert in 2019, in terms of physical volumes, export growth in 2017 amounted to 250%, in 2018 – 25% (80 thousand tons) and in 2019 – 137%. According to the results of the whole of 2020, it is expected to achieve another record indicator of Russian lentil exports [6].

The main country of consumption of Russian lentils is Turkey, it accounts for over 52% of the total structure of export supplies. It is also worth noting the growth potential of lentil exports to Iranian consumers. Iran's share in the total structure of lentil export operations has increased by 13% over the past three years. Canada became interested in lentils only in the 70s of the twentieth century, it is already ahead of other countries. The gross harvest of lentils in Canada in recent years has reached about 2 million tons. With a significant increase in the volume of lentil exports from Russia, its structure by type remains stable, which looks as follows: green lentils accounted for 73.9% of all exports, red lentils-18.8%, the share of other lentils was 7.3% [7].

Also, I would like to note a negative trend in the culture of lentil consumption in the domestic market: the average annual volume of the domestic market in the past five-year period, according to the calculations of the AB-center, amounted to 46.8 thousand tons; the volume of lentil consumption in Russia by the end of 2019 decreased by 15% compared to the indicators of previous years [3]. Thus, in modern economic conditions, it is relevant not only to search for the use of lentils as a raw export product, but also to expand the potential for using lentils [8].

Grain farming should be developed on a strictly balanced basis, taking into account all needs. It should be noted that the gross harvest of lentils depends more on the yield and weather conditions, and territoriality will play an important role in the success of the latter [9].

2. Research results

Weather and climatic conditions are always in the first place to get a good harvest. Lentils are no exception. Climate change affects temperature regimes and precipitation, which in turn affects crop yields and production.

Consider lentils, one of the agricultural crops that is a good precursor that enriches the soil with nitrogen, leaves it clean of weeds, is not capricious to the state of the soil and is useful in crop rotation, it can withstand frosts up to -50°C. A favorable temperature during the growing season should be within 12-21°C of heat. When sown in cold soil at extreme temperatures, the field germination of lentil varieties decreases sharply. Frosts in -60°C lentil seedlings are easily tolerated. But, nevertheless, the cold tolerance of the culture in the development phases after germination is somewhat reduced. After the emergence of seedlings, the culture is more demanding of heat and usually grows at a temperature of 17-19°C. Depending on the external conditions, a total of temperatures from 1350 to 19000°C is required for the full development of lentils, and in dry years this indicator decreases by 1000°C [10].

Lentils are demanding for heat and the optimal ripening temperature should be 19-20°C. It grows at a temperature of less than 19°C, but at a temperature below 14°C it stops growing. Unlike bluegrass and grain crops, lentils need more moisture, the soil moisture should be at least 93.3 % for seed germination [11].

Lentils are well born on loose, light, sandy loam soils, loamy and sandy differences of chernozems and chestnut soils.

The highest yields of lentils are obtained on loamy and sandy differences of chernozems, chestnut and light podzolic soils. On dry sandy and low-lying soils with a close standing of ground water, prone to waterlogging, as well as on saline and heavy clay and acidic soils, lentils grow poorly and give a low seed yield. On slightly saline soils (the chlorine content is 0.02-0.03%), lentils grow slowly and give a very low seed yield. But soils that are excessively rich in nitrogen are unsuitable for lentils. On such soils, it develops a large green mass, gets fat. For these reasons, lentils do not tolerate fresh manure and high rates of mineral nitrogen fertilizers. The best soils for it are lime-rich ordinary chernozems [12].

Due to the increase in temperature and changes in climatic conditions, the Lower Volga region in the steppe zone has unlimited opportunities for the successful development of agriculture. Due to climate change, the climate is changing, and it is becoming more arid.

The impact of climate change on our planet and in our country as a whole cannot go unnoticed – temperatures are changing. In June 2019, there were significant fluctuations in air temperature in the south of Russia, which contributes to an increase in the duration of the growing season with warming, the risk of drought increases in the main grain-producing regions of the Russian Federation, there is a shortage of precipitation at elevated abnormal temperatures [10].

Higher weather variability is associated with a higher frequency of abnormal heat events, floods and droughts. Consequently, increasing the stability of crop production in a changing climate is becoming vital for the sustainability of agriculture. Legumes play an important role in the diversification of existing farming systems in arid areas. Lentils require less water than for cereals or oilseeds.

The prospect of global warming in the coming decades and the risk of local cooling, rising temperatures and precipitation fluctuations, extreme climatic events, rising water levels and shifts in climate zones will undoubtedly cause serious problems regarding adaptation.

The impact of warming on agricultural productivity is ambiguous. In some areas with a temperate climate, yields may increase in the case of a slight increase in temperature, but will decrease in the case of significant temperature changes.

Therefore, the Volgograd region is ideally suited for expanding the acreage of lentils, which will significantly provide agriculture with valuable vegetable protein and expand the export opportunities for environmentally friendly products.

Canada, as one of the world leaders in growing lentils, is located at the same latitude with the regions of the Saratov and Volgograd regions. As climate change develops in Canada, the average

annual and seasonal temperatures in the vegetation zone will increase, and precipitation regimes will change (Kulshreshtha and Wheaton, 2013). Canada has a subarctic, temperate continental, Arctic climate, where the climatic conditions are similar to our regions in Figure 2 is highlighted in green, where it is a favorable territory, as well as the countries of Germany, France, the Czech Republic, Poland. For growing lentils, it is favorable in the 50th parallel of northern latitude - the latitude that is equal to 500 north of the Earth's equator. It crosses Europe, Asia, the Pacific Ocean, North America and the Atlantic Ocean.



Figure 2. The most favorable zone for growing lentils.

The Volga Economic Region includes 94 major cities, three of which are million-strong: Kazan, Samara, Volgograd. Other major cities are Togliatti, Astrakhan, Saratov, Engels, etc. The land fund of the Saratov region is 10123.9 thousand hectares. The climate of the region is temperate continental. It is characterized by hot summers and cold, snow-free winters. The land fund of the Penza region in terms of the area of waterlogged agricultural land in the region is 204 thousand hectares. The climate is moderately continental with relatively warm summers and moderately cold winters. The Volgograd region occupies agricultural land with an area of 11,290 thousand hectares. The climate is continental with cold, snow-free winters and long, hot, dry summers.

The land fund of the Altai Territory is the largest region of the Russian Federation in terms of the area of arable land and agricultural land on agricultural land and amounts to 15799.6 thousand hectares. The climate is temperate and sharply continental, formed as a result of frequent changes in air masses coming from the Atlantic, the Arctic, Eastern Siberia and Central Asia.

3. Conclusions

Lentils are a product that plays an important role both in human nutrition and in providing animals with micro - and macronutrients, as well as in ensuring high-quality crop rotation. In Russia, the Saratov and Volgograd regions are in good soil and climatic conditions for growing lentils. Global climate change only improves these conditions. Being the agricultural centers of Russia, they have the necessary infrastructure for the successful production of this crop. In addition, they are located in a favorable economic and geographical position, close to large consumers of lentils on the world market. Thus, the expansion of lentil production is a necessary step in ensuring the environmental and economic security of the country's development.

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