

# POTENTIALS FOR THE DEVELOPMENT OF AGRICULTURAL PRODUCTION IN THE AREA OF KLADOVO

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## Abstract

*The subject of research is climate, land and other natural resources in the Braničevo district, for the municipality of Kladovo. The aim of the research is to consider the natural potentials for intensifying and improving agricultural production. Climate parameters were analyzed: maximum, minimum and average temperature, air pressure, relative humidity, wind speed, insulation, precipitation, etc., soil types and water resources. Based on the established indicators of natural potentials, it is possible to predict and plan appropriate agricultural production, as well as to direct activities to avoid or mitigate potential risks and limitations.*

**Key words:** *natural resources, agricultural production, Kladovo*

## Introduction

Agricultural production is conditioned by multiple factors that directly or indirectly affect its intensity and effectiveness (Kljajić & Popović, 2011; Kljajić et al., 2015). Regardless of the increase in production weald in primary agricultural production as a result of breeding and improvement of cultivation technologies, viewed globally, climate change has a negative impact on overall world food production (Morgounov et al., 2018). Climate change is also having a negative impact on socio-economic aspects related to food production systems and safety, transport, demographic change and human behavior (Tirado et al., 2010). Climate indirectly affects the water regime of land under agricultural crops, their growth and yield per unit area. Drought stress in the last two decades has had negative consequences for overall agricultural production (Janković & Kovačević, 2019). Water use efficiency is the relationship between total dry matter and evapotranspiration.

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Water scarcity during the growing season is a significant limiting factor in achieving high and stable yields and quality (Arsić *et al.*, 2013). In the tissues of all life forms on Earth are from 50 to 80 % water.

Land, as one of the most important a natural resource is being improved, but it is also subject to negative changes. By introducing new varieties, hybrids, agrochemicals (i.e. plant protection products and mineral fertilizers), as well as agricultural machinery, while reducing the work involved, provides adequate yields. Welch & Graham (1999) point out that this system of production, despite the numerous benefits reflected in the increase in production, endangers the environment - salinization of the soil, concentration of toxic residues, pollution of water and air. Changes in soil are the primary factor that determines the absorption and accumulation of mineral elements in plants (White & Broadley, 2009; Živanović *et al.*, 2015). To date, studies of cultivated plants do not provide reliable results on whether the root system of modern varieties is adapted to soil and environmental factors and whether it is necessary to make changes by breeding (Zhu, 2019).

Soil fertility is variable and depends on its physical, chemical and biological characteristics, as well as on climatic parameters, relief, proximity to rivers, applied agro-technical measures, etc. “Costs that address the issue of environmental liability, in some cases, exceed the value of the assets in many cases, so that their precise calculation requires determination of the ecological, physical, geological and hydro-geological characteristics of the site, as well as the type and quantity of harmful substances” (Sredojević *et al.*, 2019). Accordingly, in these paper are analyze the natural potentials of the Kladovo area in the function of improving and further developing economically justified agricultural production.

### **Materials and Methods**

In order to consider the climatic characteristics the municipality of Kladovo, the average monthly values of the basic climate parameters for the period 2010-2020 were analyzed years. Data from the main meteorological station “Negotin”, which is located at an altitude of 42 m, were used, with coordinates: latitude 44 ° 14´ and longitude 19 ° 55´. Based on the data from Statistical Office of the Republic of Serbia (SORS), important indicators of agricultural production in the analyzed area were determined.

## Results and Discussions

**Climatic characteristics** - Climate significantly affects the overall development of the economy and activities in an area. Systematic meteorological measurements lasting several decades enable a valid assessment of the current state of the climate as well as a comparison with previous periods. In the area of Kladovo, the climatic conditions are characterized by a typical continental character, with certain specifics. It is characterized by dry and warm summers with little precipitation, which significantly affects the reduction of yields in agriculture, and long and cold winters with snow cover since November. Starting from specific data, regularly registered in a longer period of observation and action of climate factors, the important features of the following climate parameters are considered (Table 1 i 2).

**Table 1.** Parameters of air pressure, temperature and relative humidity of the meteorological station of Negotin, 2010-2020.

Year	Air pressure (med, mb)	Air temperature (°C)			Relative humidity (medium, %)
		max	min	medium	
2010	1,008.9	17.2	7.7	12.2	72
2011	1,013.3	17.9	6.8	12.3	67
2012	1,011.1	18.9	7.5	13.2	64
2013	1,010.7	17.9	7.8	12.9	71
2014	1,011.2	17.4	8.5	12.7	77
2015	1,013.1	19.0	8.3	13.7	69
2016	1,011.8	18.4	8.1	13.1	71
2017	1,012.0	18.8	7.6	13.2	66
2018	1,011.4	18.6	8.3	13.1	73
2019	1,010.8	19.5	8.6	13.9	70
2020	1,012.1	19.2	8.4	13.7	69
Average	<b>1,011.5</b>	<b>18.4</b>	<b>8.0</b>	<b>13.1</b>	<b>69.9</b>

Source: Calculation based on data from meteorological yearbooks of Institute of Hydrometeorological of the Republic of Serbia, 2010-2020.

From the parameters, the following were analyzed: Maximum, minimum and average air temperature (T, °C); Air pressure (mb); Relative humidity (RH,%); Wind speed, measured at 2 m above the ground (V, m / s); Insolation (n, time); Cloudiness (tenths), and Precipitation (P, mm). The average annual value of maximum temperature of air in the area of Kladovo is 18.4 °C. Average annual value of minimum temperature of air is 8.0 °C. Air pressure values range from 1,008.9 – 1,013.8 mb, while the average annual value is 1,011.5 mb. Relative humidity is

characterized by a certain regularity of phenomena that is inversely related to air temperature. Monthly values of relative humidity well follow the monthly values of air temperature, but in the opposite direction. The average annual value of relative humidity of the observed period for the area of Kladovo is 69.9%. The wind speed is in the range of 1.0-1.7 m / s, with the annual average being 1.5 m / s. Winds affect other climate parameters (air temperature, relative humidity, etc.), and also the soil, because they increase its evaporation. The average annual insolation in this area for the observed period is 2,270.1 hours. The average annual cloud cover is 4.8 / 10 of the sky. This area is characterized by an average annual rainfall of 680.1 mm. This amount of water sediment is unevenly distributed by seasons and months.

**Table 2.** Parameters of wind speed, insolation, clouds and precipitation of the meteorological station of Negotin, 2010-2020.

Year	Wind speed (medium, m/s)	Insolation (h)	Cloudy skies (medium, the number of days)	Precipitation (sum, mm)
2010	1.5	1,995.9	5.5	737.1
2011	1.5	2,497.8	4.2	352.4
2012	1.6	2,582.8	4.2	532.5
2013	1.5	2,220.1	4.9	700.1
2014	1.3	1,897.8	5.9	1,237.2
2015	1.5	2,353.0	4.5	732.1
2016	1.6	2,195.5	4.8	744.7
2017	1.7	2,364.2	4.5	565.5
2018	1.3	2,223.9	5.0	738.6
2019	1.4	2,333.4	4.6	569.3
2020	1.5	2,306.9	4.8	571.6
Average:	<b>1.5</b>	<b>2,270.1</b>	<b>4.8</b>	<b>680.1</b>

Source: Calculation based on data from meteorological yearbooks of Institute of Hydrometeorological of the Republic of Serbia, 2010-2020.

**Land types** - Of the total area of Kladovo, i.e. 62,628.33 ha, water areas occupy 3,634.67 ha ( $\approx 4\%$ ). Of all the represented soil types, there are the most luvisols and soils in leaching ( $\approx 37\%$ , i.e. 23,314.53 ha), as well as eutric cambisol ( $\approx 28\%$ , i.e. 17,351.18 ha). Calcomelanosols, syrosomes and lithosols on limestone are present in a slightly higher percentage ( $\approx 13\%$  and 8,119.43 ha, respectively), while other soil types are present in a smaller percentage. Of the represented types of land, chernozems and alluvial deposits along the watercourses certainly have the greatest productive capacity, so it is possible to successfully cultivate field crops in this area.

**Table 3.** Land types in the area of Kladovo.

Land type	Surface area (ha)	Share (%)
Water surfaces	2,634.67	4.21
Arenosol and syrose on sand	1,316.82	2.10
Chernozem	1,112.68	1.78
District cambisol and occasional ranker	3,062.15	4.89
Eutric cambisol (grove)	17,351.18	27.70
Fluvisol	1,616.67	2.58
Humofluvisol	848.05	1.35
Humogley and eugley	343.00	0.55
Calcocambisol and calcomelanosol	1,541.93	2.46
Calcomelanosol, syrosome, lithosol on limestone	8,119.43	12.96
Colluvium	413.05	0.66
Luvisol and land in leaching	23,314.53	37.23
Pseudogley	532.74	0.85
Ranker, syrose, lithosol on sandstone, flysch and hornblend	241.11	0.38
Ranker, syrup, lithosol on shale and gnei	144.73	0.23
Ranker, syrup, lithosol on shale and gnei	35.58	0.06
<b>Total:</b>	<b>62,628.33</b>	<b>100.00</b>

Source: Possibilities for growing fast-growing energy crops from the aspect of availability of agricultural land in RS, UNDP, BG, 2017.

Groves and brown soils are very suitable for fruit and vineyard production. Pseudogley soils, as well as mineral-wetland soils can be adapted to agricultural production, with intensive drainage using horizontal pipe drainage, which is at the same time a prerequisite for the application of irrigation on these areas.

**Water resources** - The area of Kladovo is characterized by an extensive hydrographic network, with the Danube as a river of large water capacity. The construction of the hydroelectric power plant “Djerdap I” near Kladovo created the largest artificial lake in Serbia, the so-called Djerdap Lake. Thanks to the creation of this lake, the Danube became navigable through the Djerdap gorge. Apart from the Danube, in the area of Kladovo, of the larger watercourses, there are the Great River and the Podvrška River, which flow into the Danube, then a large number of springs, and several thermal springs, as well as a large number of streams. Watercourses are mostly torrential and belong to the basin of the right bank of the Danube. Given the connection with surface waters, groundwater is part of the total water resources of this area. Well water is less used in the lowland part of the Kladovo area, while in mountainous areas almost every household has its own well. The Danube basin in the territory of our country is shown in a Figure 1.

**Figure 1.** Danube River Basin.



Source: [http://www.hidmet.gov.rs/ciril/hidrologija/povrsinske/sliv\\_dunav.php](http://www.hidmet.gov.rs/ciril/hidrologija/povrsinske/sliv_dunav.php)

**Agricultural production** - The number of farms in the municipality of Kladovo is 1,912, which is 17.02% of the total number of agricultural farms in the Bor area (Table 4).

**Table 4.** Number of agricultural holdings in the area of Kladovo, 2018.

Region/ Area	Kladovo	Borska area	Southern and Eastern Serbia	Republic of Serbia
Number of households	1,921	11,285	164,802	564,541
Used field. land (ha)	12,165	78,611	719,997	3,475,894
Arable land and gardens (ha)	7,404	45,266	460,046	2,571,580
Orchards (ha)	165	1,384	50,908	182,923
Vineyards (ha)	189	1,101	7,472	20,466
Meadows and pastures (ha)	4,274	30,093	195,838	676,724
Other	133	767	5,733	24,201

Source: <https://www.stat.gov.rs/>

In 2018, there were 12,165 ha of used agricultural land in the territory of this municipality, of which arable land and gardens were represented on 7,404 ha, orchards on 165 ha, vineyards on 189 ha, meadows and pastures on 4,274 ha.

Areas under production of important crops in the municipality of Kladovo are: corn for grain on an area of 1,938 ha, cereals on 5,560 ha, legumes on 76 ha, potatoes on 26 ha, oilseed rape on 75 ha, sunflower on 1,138 ha, vegetables, melons and strawberries on 58 ha, fodder plants on 349 ha, and the rest on 4,178 ha (SBS, 2020) Vegetables, melons and strawberries are irrigated mostly, followed by sugar beets and legumes and other crops much less (Table 5).

**Table 5.** Grown plant Crops in the area of Kladovo, 2018.

Species plant crops	Region/ Area	Kladovo (ha)	Irrigated areas in Kladovo (%)	Borska area (ha)	Southern and Eastern Serbia (ha)	Republic of Serbia (ha)
Corn for grain		1,938	1.24	11,236	157,893	900,048
Cereals		5,560	0.54	32,044	334,278	1,702,829
Legumes		76	3.48	204	2,733	7,834
Potato		26	11.55	314	6,062	27,701
Sugar beet		0	0	2	49	44,898
Rapeseed oil		75	0	76	1,921	45,575
Sunflower		1,138	0	4,822	25,507	239,794
x*		58	98.01	966	11,898	50,107
Other		4,527	1.17	30,151	268,749	1,120,684

Source: <https://www.stat.gov.rs> (\*Vegetables, melons and strawberries)

“Cost-benefit analysis is seen as one component of a broader assessment within integrated area management. In relation to the application of standard financial analysis, Cost-Benefit analysis also covers the social dimension” (Sredojević & Gajić, 2020). In the district of Southern and Eastern Serbia, in terms of the method of irrigating agricultural crops, dew is the most common, followed by dripping and finally surface irrigation (Table 6).

**Table 6.** Areas and their share according to the method of irrigation in the Southern and Eastern Serbia, 2018

The way irrigation	Southern and Eastern Serbia		Republic of Serbia	
	Surface area (ha)	Share (%)	Surface area (ha)	Share (%)
Superficial	19	0.30	59	0.12
Sprinkling	5,048	79.96	43,253	92.30
By dripping	1,246	19.74	3,550	7.58
Total:	6,313	100.00	46,863	100.00

Source: <https://data.stat.gov.rs/Home/Result/25010204?languageCode=sr-Cyr>

Simultaneously with the preparation of project documentation for the construction of irrigation systems, it is necessary to start organizing individual producers, future users of the system in the association of irrigation water users and their education in the direction of approaching market conditions. In that sense, PTK “Ključ” is suitable for operational involvement in the project as an “umbrella”, i.e. the center of all activities in the process from organizing production in the conditions of irrigation, system maintenance, as well as to the placement of production. Thus organized individual producers would be able to develop high and quality plant production, diverse economic activities and ensure the economic stability of family farms.

### **Conclusion**

The Kladovo area belongs to the climate zone temperate-continental climate, with of large temperature oscillations, extremely cold winters and warm summers. Problems that characterize agricultural production in the area are: a wide range of production of small quantities of products, financing of primary production, low productivity, improper quality management, technological inferiority to competition, as well as low level of knowledge in marketing. Hydromeliorative measures (irrigation and drainage) are still, to a small extent, represented in this area. When planning the spatial and functional organization of the area, one should take into account all natural resources that are important in the implementation of investments in agriculture. Given the favorable climatic conditions, the richness of water resources and land of good quality and production value, for the development of the Kladovo region, agricultural production should be intensified by introducing complex agro-technical measures.

### **Acknowledgment**

This paper is a result of the research conducted within the framework of the Agreements of the implementation and funding of scientific-researchs in 2021 made between the Institute of Agricultural Economics, Belgrade and the Ministry of Education, Science and Technological Development of the Republic of Serbia, the registered No. 451-03-9/2021-14/200009, and researchers at the Faculty of Agriculture, Belgrade-Zemun, No. 451-03-9/2021-14/200116



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