NATURAL CHARACTERISTICS AS A BASE FOR THE SUSTAINABLE AGRICULTURAL PRODUCTION – THE MUNICIPALITY OF TEMERIN EXAMPLE[1]

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Abstract

The climate, pedological and hydrological characteristics as a base for planning agricultural production in the region of Vojvodina (the Municipality of Temerin area, the South-Backa administrative district) were represented in this paperwork. This research goal was to show the summarized data on the climate parameters, the representation of soil types, hydrological resources, number of agricultural husbandries and the utilised agricultural land in this research area. The data were collected from the relevant strategic and statistical documents, as well as the scientific paper works in which a similar topic has been studied. According to the results obtained from the research and discussions has concluded that this area of the South-Backa administrative district has been very favourable for the diverse agricultural production. These results are also significantly important for further planning of agricultural production and its intensification by the farmers in the Temerin Municipality.

Key words: *climate indicators, pedological characteristics, hydrological characteristics, the utilised agricultural area.*

Introduction

One of the crucial challenges of the Century we live in are the climate changes. These changes have seized the whole planet Earth, and thereby our coun-

1 Paper is a part of research financed by the MSTDI RS and agreed in decision no. 451-03-47/2023-01/200009 from 03.02.2023.

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try. Changes reflect in a marked change and variability in air temperature, especially in summer months, and more marked precipitation variability. The precipitation deficiency in Serbia has been particularly present since ‘80s of 20th Century (Popović et al., 2009). In parallel, there was also present concern about influence of the global climate changes on agriculture, which have been traditionally one of the most important sectors of Serbian economy, and thereby factors that affect agriculture have simultaneously affected the entire Serbian economy (Lalić et al, 2011).

In the sector of agriculture, the climate changes show their presence through the meteorological droughts frequency as a result of the increased air temperatures and reduced amounts of precipitations during summer time. This is what reflects in the reduction of agricultural species’ yield and has a chain transmission to a price of agricultural products. On the other hand, agricultural land as well as a basic factor of agricultural production are one of the most important factors and basic resource for the food production requires a responsible management both for the agricultural land and environmental preservation (Zubović et al, 2017). Due to increasing climate changes and their significant effect on the agricultural production, for planning and initiating the agricultural production or its intensification where possible, it is important to study land and climate indicators as well as the presence and opportunity of water resources use in the specific region for the irrigation apply during the vegetation period of a cultivated plant.

The rational use of natural resources through financial support can enable good long-term positioning of agricultural products from our country, as on domestic as well as on the international market (Đurić and Prodanović, 2017).

Agriculture is a supporting column of the Republic of Serbia economic development. However, besides a huge potential which the agricultural production has thanks to the favourable natural conditions (favourable climate conditions, availability of a great production capacity land and availability of water resources), it hasn’t been sufficiently developed (Subić et al., 2022). Owing to the importance of agricultural sector for the development of the Temerin municipality, this research’s goal is to perceive natural factors that have an effect on the agricultural production success and its improvement.

Materials and Methods

The approach to a descriptive statistic (DESK) was used for the analysis of climate and pedological indicators in the municipality of Temerin. There were used empirical data taken over from the electronic database of the Statistical Office of the Republic of Serbia, as well as the Republic Hydrometeorological Service of Serbia. Strategic documents of the municipality and the Republic of Serbia, such as the Local Waste Management Plan of Temerin Municipality, the Spatial Plan of Temerin Municipality, the Development Strategy of Temerin Municipality, the Strategy of Agriculture and Rural Development of the Republic of Serbia supported the research on a given topic. These documents helped finding data related to the climate, pedological and other relevant parameters. Besides, there were used also the related scientific paper works, which had studied the same or similar problem, and provided additional information on the given topic in this paper work.

Research results and discussion of the results

Within the research results were shown natural characteristics of the Temerin municipality region, one of the municipalities that represented a part of the South-Backa District. Those characteristics comprised studying climate through its basic indicators, and furthermore studying different pedological types represented in this territory, number of registered agricultural husbandries, areas (in ha) under crops in the field of vegetable growing, fruit growing and viticulture, areas under industrial and fodder, as well as areas for livestock production.

Climate characteristics

Climate, as one of the crucial natural factors, has an important effect on the development of economy and society of the related area, and especially on agriculture. Climate of Vojvodina is moderately-continental with certain particularities. It is characterised by hot summers and cold winters, while springs and autumns last shortly. Summer temperatures range from 21°C to 23°C, and winter temperatures range in average -2°C. However, there are great extremes in temperatures, and therefore differences between the lowest and the highest values can amount up to 70°C (Popović et al, 2005.)

For in-detail perception of the climate specificities of the Temerin municpality area, there were analysed the mid-month values of the climate parameters for

the period 2012-2022, as well as the mid-annual values derived from its parameters' monthly values in the meteorological station „*Rimski Šančevi/Novi Sad*[5]". The parameters comprised by the analyses are: *Maximum, minimum and middle temperature of air (T, ºC); Air pressure (mb); Relative air humidity (RH, %); Numer of days with strong (>6Bft) and torrential wind (>8Bft), (V, day); Insolation (n, hour); Cloudiness (tens); Precipitation (P,mm).* These parameters values are shown in the table 1 and chart 1.

Table 1. Value of the climate parameters from the Meteorological Station Rimski Sancevi (Novi Sad) for the period 2012-2022

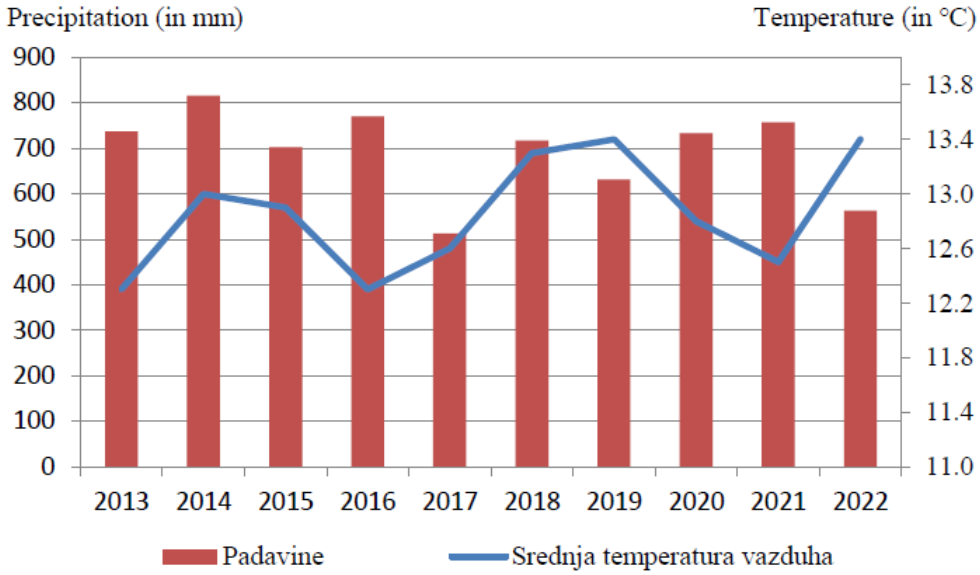
Year	Air pressure (mb)	Air temperature (ºC)			Relative air humidity (%)	Wind speed m/s)	Insolation (n)	Cloudiness (number of days)	Precipitation (mm)
		max	min	Average					
2013	1,005.6	17.8	7.4	12.3	77	2.4	2,113.1	5.5	737.4
2014	1,005.5	18.4	8.4	13.0	78	2.6	2,059.5	5.7	816.0
2015	1,008.5	18.3	7.9	12.9	76	2.2	2,288.5	5.1	702.7
2016	1,007.1	17.7	7.5	12.3	78	2.6	2,155.6	5.5	770.7
2017	1,007.4	18.4	7.2	12.6	72	-	2,415.2	5.1	513.1
2018	1,006.1	18.8	8.4	13.3	75	-	2,260.1	5.5	717.1
2019	1,005.9	19.3	8.2	13.4	73	-	2,336.3	5.1	632.1
2020	1,007.4	18.4	7.8	12.8	73	2.7	2,275.1	5.2	733.2
2021	1,006.7	18.2	7.4	12.5	73	2.8	2,338.3	5.0	757.6
2022	1,00.,8	19.3	7.9	13.4	70	2.6	2,443.5	4.9	563.6
Average	**1,006.8**	**18.5**	**7.8**	**12.9**	**74.5**	**-**	**2,268.5**	**5.3**	**694.4**

Source: Calculation according to data from the meteorological yearbooks (climate data) of the Republic Hydrometeorological Service of Serbia, Belgrade, 2012-2022

The average value of air pressure is 1006.8 mb. Maximum air temperatures range from 17.7 ºC (2016) to 19.3 ºC (2019 and 2022), while minimum air temperatures range from 7.2 ºC (2017) to 8.4 ºC (2014 and 2018). Middle temperatures of air were shown in the chart 1, together with precipitation, and were in average 12.9 ºC.

5 Elevation 86 m, latitude 45°19'N, longitude 19°50'E

Chart 1. Review of precipitation and air temperatures' middle values



Source: Authors' presentation according to the database of the Republic Hydrometeorological Srvis of Serbia

The precipitation regime of Vojvodina has partly characteristics of the Danube regime. This implies unevenness by months during a hydrological year and during a vegetation period of plant species, and therefore often due to the insufficient quantities of available water to plants in the zone of a root system, the lack of water must be replaced by irrigation. There can be singled out the particularly rainy periods in the beginning of summer (especially in June), as well as periods without or with negligible quantity of precipitation (October and March). Short summer storms with hail and heavy rainfall are possible during summer time.

The average values of total precipitation for the period 2012-2022 were 694.4 mm per year.

The data on wind speed are incomplete, because some monthly measurements in the specific years are missing, and therefore there cannot be presented an average value of wind speed. Winds that mostly blow in Vojvodina are: „košava"cold and strong wind, with great energy potential as a drive for the wind power plants in Banat; „severac", also cold wind; „south"warm wind; and „west" wind that brings precipitation through rainfall or snow (Wind At-

las of AP Vojvodina, 2008). For the Temerin area are characteristic strong winds, which blow from the southeast direction mainly in the colder half of the year, primarily koshava (košava), while winds from the northwest direction blow during spring and summer (Local Waste Management Plan for the Temerin Municipality, 2011).

A total number of sunny hours (in average) for the Temerin Municipality is 2,268.5 hours, and the average cloudiness is 5.3.

Soil

The most represented types of soil in the region of Temerin Municipality are *chernozem, humogley*, *eugley*, *humofluvisol*, *solanchak* and *solodj*. The spatial presence of these soil types is expressed in ha and shown in the table 2, as well as a percentage share in relation to a total area of these soil types.

Table 2. Types of soil in the Temerin municipality

	Temerin	
	Areas (ha)	***Share (%)***
Chernozem	14,244.06	84.01
Humogley and Eugley	475.37	2.80
Humofluvisol	1,139.01	6.72
Solonchak and Solonetz	1,096.84	6.47
Total	**16,955.27**	**100.00**

Source: Report „Possibilities for cultivation of fast-growing energy crops from the agricultural land availability in RS point of view Republic of Serbia. Ministry of Mining and Energy, Ministry of Agriculture and Environmental Protection. UNDP Serbia. Belgrade, 2017

Since the production of food is related mostly to soil, the care about land is inevitable, and therefore is necessary to overtake all adequate measures of soil protection and implement a predetermined goal for its sustainable use (Kljajić et al, 2012).

Water wealth

The water wealth is constituted of the surface and ground water, which are connected to the surface and therefore makes an inseparable part of water resources when considering the water balance. The largest part of the Republic of Serbia territory, and therefore the AP Vojvodina, belongs to the Black Sea basin, i.e., the Danube basin. Hydrological network of regional station Novi Sad is shown in the Image 1.

On the territory of the Temerin Municipality all water flows have been turned into canals and included in the Danube-Tisa-Danube hydro system, which has been used in agriculture (for irrigation) and drainage of the excess waters.

The river Jegricka is the longest water flow in the south part of Backa loess plain and the territory of Temerin Municipality. Jegricka is 64.5 km long and flows into the river Tisa on the right side. *Kisac Canal* flows through Sirig (flow length is 16 km), and it flows into the Jegricka river east of the settlement. The other water flow is *Beli Canal* or *Bela Bara*, which starts south from Backi Jarak, slightly turns to the north in west part of Temerin and flows into Jegricka. The flow is channelled from Temerin to the confluence. In east part of the Temerin Municipality there are minor channelized water flows, such as *Ciganka* and *Mala Bara.* There are no natural lakes here.

Image 1. Network of surface water stations – Hydrological regional station Novi Sad

Source: https://www.hidmet.gov.rs/ciril/hidrologija/povrsinske/hrs_novi_sad.php

Groundwater on the territory of Temerin Municipality is present as the *artesian and phreatic water*. The artesian water, which use for exploitation, appears in greater depths of 100 m, even up to 300 m. The abundance of these layers is small and amounts 5 l/s, and in optimal conditions up to 10 l/s.

The phreatic water appears in the water permeable layers of soil at a shallow depth. The upper level of the phreatic aquifer moves freely depending on inflow of water and soil evaporation.

Thermo-mineral waters were located in Temerin in 1914. This water is beneficial and is used for swimming in pools, and also for bathing in tubs.

The utilised agricultural area

The South Backa District, where the Temerin Municipality is located, has 26,297 agricultural husbandries, or 20.7% of a total number of AH in the region of Vojvodina, and 4.7% of a total number of AH in the Republic of Serbia (table 3).

Table 3. General data on the agricultural husbandries and the utilised agricultural area

	Republic of Serbia	Vojvodina Region	South Backa District	Temerin Municipality
Number of husbandries	564,541	127,070	26,297	1,367
Utilised agricultural area (ha)[6]	3,475.894	1,574.366	273,729	14,480
Ploughland and gardens (ha)	2,571.580	1,433.130	262,394	13,984
Orchards (ha)	182,923	19,494	3,626	146
Vineyards (ha)	20,466	4,614	730	21
Meadows and pastures (ha)	676,724	112,742	6,086	305

Source: Census of Agriculture, Survey on the agricultural husbandries' structure, 2018

The utilised agricultural area in the South Backa area is located on 273,729 ha, or 7.9% of the utilised agricultural area in the Republic of Serbia, and 17.4% of the utilised agricultural area in the region of Vojvodina. There are 1,367 registered agricultural husbandries on the territory of the Temerin Mu-

6 *The utilised agricultural area is composed of: agricultural area in garden plots, ploughland and gardens (including fallow land), permanent plantations – orchards, vineyards, nursery gardens, basket willow plantations, areas under female rushes, carob plants, areas where truffles grow, as well as plantations of fir trees for sale (Christmas trees), and meadows and pastures that are regularly cultivated – u*tilised.

nicipality, and 14,480 ha of the utilised agricultural area, or 0.4% of the totally utilised agricultural area at the republic level, and 0.9% of the utilised agricultural area at the South Backa area level.

Cereals are mainly represented on the territory of the Temerin Municipality on area of 8,334 ha, and then industrial crops on area of 4,392 ha, vegetable, melon plantations and strawberries, on area of 137 ha, and legumes on the total area of 12 ha (table 4).

Table 4. Number of husbandries and areas under arable and vegetable crops

	Republic of Serbia	Vojvodina Region	South Backa District	Temerin Municipality
Cereals (total) in ha	1,702.829	879,312	133.873	8,334
Legumes (total) in ha	7,834	2,635	350	12
Industrial crops (total) in ha	493,570	426.158	97,920	4,392
Fodder (total) in ha	230,323	50.172	7,796	74
Vegetables, melon plantations and strawberries (total) in ha	50,107	20.665	6,662	137
Flowers and decoration plants (total)	440	196	26	7
Seed and planting material for sale (total)	3,806	3,506	1,211	71

Source: https://data.stat.gov.rs/Home/Result/1300020201?languageCode=sr-Cyrl&displayMode=table&guid=18db8167-285a-4665-b02e-e118ffb57e99(na dan 12.10.2023.)

Orchards are widespread on totally 146 ha. There are mostly apricots on 52 ha and apples on 51 ha. Raspberries are grown on 18 ha, plums on 13 ha, and pears on 11 ha, while according to the Census of Agriculture there are no other fruit species (table 5), maybe in smaller areas, i.e. garden plots.

Table 5. Number of husbandries and areas under fruits

	Republic of Serbia	Vojvodina Region	South Backa District	Temerin Municipality
Number of husbandries (total)	270,847	18,505	3,170	218
Orchards (total)	182,874	19,493	3,626	146
Apples	26,680	7,440	1,471	51
Pears	4,977	1,114	236	11
Peaches	5,178	1,024	140	0
Nectarines	1,129	124	22	0
Apricots	6,039	1,030	256	52
Cherries	4,330	485	137	0
Sour cherries	19,613	1,705	253	0
Plums	72,983	2,582	342	13
Quinces	1,950	228	57	0
Nuts	2,796	418	69	0
Hazelnuts	4,564	2,335	369	1
Almonds	9	5	2	0
Other fruit species	534	37	12	0
Raspberries	24,899	739	248	18
Blackberries	6,055	23	3	0
Blueberries	644	134	0	0
Other berry fruits	495	69	8	0

Source: *https://data.stat.gov.rs/Home/Result/1300020204?languageCode=sr-Cyrl&displayMode=table&guid=ca2116fd-7557-4777-a41d-72a5799704e5(na dan 12.10.2023.)*

In the Backa Region 76 husbandries have vineyards, which makes only 1.3% of the total number of agricultural husbandries in this area. Viticulturists are mainly settled in the Municipality of Odzaci, although the largest area under vineyards has the Temerin Municipality (Viticulture Atlas, 2015). Vineyards in the Temerin Municipality are located on 21 ha, while the most represented are grape varieties for the production of red wine, or 71% (table 6).

Table 6. Number of husbandries and areas under vineyards

	Republic of Serbia	Region of Vojvodina	South Backa Region	Temerin Municipality
Number of husbandries (total)	602.228	4.684	762	48
Vineyards (ha)	20.466	4.614	730	21
Grape varieties for the production of wine with a geographical indication	2.065	793	42	1
Varieties for production of red/rose wine	9.028	2.453	290	15
Varieties for the production of white wine	3.303	808	250	2
Table grape varieties for eating	6.070	560	149	3

Source: https://data.stat.gov.rs/Home/Result/1300020206?languageCode=sr-Cyrl&displayMode=table&guid=ae16d462-2e26-4824-b0b9-ad2d12007811 (na dan 12.10.2023.)

Wines from this area have an important place in the wine supply of Vojvodina, and contribute significantly to the development of rural tourism. The most important varieties of wine are: *Chardonnay, Cabernet sauvignon, Rose, etc.*

Livestock breeding

As we can notice from the table, there prevails the breeding of pigs and poultry on the territory of the Temerin Municipality. The Temerin Municipality is not abundant with pastures and meadows, and the breeding of sheep isn't developed. The number of pigs is 197 on 100 ha of ploughland, while at the South Backa District level 121 pigs, at the Vojvodina level 95 pigs, and at the republic level 136 pigs.

Table 7. Livestock concentration in Temerin Municipality in comparison to the regions in the Republic of Serbia, 2012

Livestock concentration per an area unit	Republic of Serbia	Vojvodina Region	South Backa Region	Temerin Municipality
Number of cattle on 100 ha of arable land	33	17	17	15
Number of pigs on 100 ha of arable land	136	95	121	197
Number of sheep on 100 ha of agricultural land	51	17	18	11
Number of poultry on 100 ha of arable land	1,063	817	1,096	1,615

Source: Development Strategy of Temerin Municipality 2016-2020

Like related to pig breeding, in the Temerin Municipality prevails the poultry breeding, which can be concluded according to an indicator of poultry concentration of 1,615 on 100 ha of ploughland, or much more than at the district (1,096), provincial (817) and republican level (1,063).

Conclusion

In accordance to the collected data analysis, there can be noticed the favourable conditions for different forms of agricultural production in this area. The climate and pedological factors result in suitability for the intensification of almost every branch of agricultural production:

- Good qualities of soil types, high production capacity, favourable climatic conditions and tradition in production make this area suitable for ***fruit production;***
- Temerin area is abundant with a large number of sunny days and favourable climatic conditions for the growing of ***vine***. This area is famous by the production of wine and every year organizes the international wine evaluation as one of the biggest wines' competitions in Serbia;
- Favourable climatic conditions, sufficient amount of precipitation and arable land make this area very favourable for growing various types of ***vegetables***. Mainly grown vegetables are: bean and potato, etc;
- This area has a developed ***livestock*** tradition, especially in pigs and poultry. Pastures provide excellent conditions for sheep grazing, and there are also good conditions for cattle breeding;

- ***Cereals, industrial and fodder crops*** are widespread, which proves the fact that Temerin is favourable area for this type of agricultural production.

The area of the Temerin Municipality still has developed production capacities and tradition in these agricultural branches. It is necessary to include the application of modern technologies and innovations, which will provide high, stable and economically justified yields in perspective that will lead to the development of a local economy. Besides, the adequate infrastructure in form of good and high-quality roads to rural areas, good water supply network and inevitable application of irrigation in production are also necessary factors for the development of agricultural sector of the Temerin Municipality. Rural tourism, together with agriculture, is an inevitable factor for improvement of rural life through the creation of a market for the local agricultural products.

One of the basic problems related to Serbian agriculture is the lack of agricultural production financing, as well as for the improvement of life and work in rural areas, i.e. in the countryside (Vasiljević et al., 2015). Consequently, there recognizes a need for subsidies in agriculture that should be directed to raising the high-quality products' yield. The current models of agricultural and rural development financing must become efficient for the users of agrarian policy measures, along with the introduction of adequate systematic changes. The agrarian policy should contribute to a growth of agricultural sector competitiveness and the reduction of a producer's/processor's income risk (Strategy of Agriculture and Rural Development of the Republic of Serbia for the period 2014-2024).

The possibility of using the pre-accession EU funds for rural development (IPARD II program) that implies a pre-accession assistance program to farmers is very important. Its main contribution should be increasing productivity and competitiveness, as well as the improvement of life quality in rural areas. This program is oriented to the development of the entire Republic of Serbia territory, including the belonging municipalities and towns.

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