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Climate as the Value of Agricultural of the Example Northeastern Montenegro

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Abstract: The paper discusses the importance of climate and development of agriculture in northeastern Montenegro, in the example of the municipality Berane andrijevica and Plav. The climate of geo-space is moderate - continental and mountain character. The paper discusses the agricultural value as a climate of north-eastern Montenegro. The paper discusses the importance of climate for the development of agriculture in north-eastern Montenegro, for example the municipality of Berane, Plav and Andrijevica. The climate of this area is mild mountainous and continental character. Analysis of climatic elements and their comparison, one can find a value for the appropriate climate for agriculture. Combining the favorable and limiting factors, we have selected three agro climatic regions which differ by level of benefits of climate conditions for agricultural development. Identifying, analyzing and studying climatic conditions for agricultural development, allows more appropriate and easier management of agricultural policy and establishing attitudes toward specific agricultural practices and developments in agriculture north-eastern Montenegro.

Key words: Agriculture · Agro-climatic area · Agro-climatic conditions · North-eastern Montenegro

INTRODUCTION

From natural conditions essential for agriculture north-eastern of Montenegro, the example of the municipality of Berane andrijevica and Plav, a prominent place occupied by climatic conditions. As a consequence of the air a number of factors and is expressed through the required elements, clearly affects the range of phenomena and processes in agriculture. Analysis of the climate elements is conditioned by the richness of the data points obtained by systematic measurements and observations of meteorological stations. What they are more numerous, more detailed and include long periods of time, so much the conclusions scientifically justified and useful for agricultural practices. In this regard, the positive effects greater density of meteorological stations and negatively, directly derived data for areas where no monitored the appropriate climatic conditions, phenomena and processes [1].

Value judgments of climate elements in the north-eastern part of Montenegro, is determined by narrow data base and lack of measurement of individual climate elements for a longer period of time. Therefore, the analysis of basic climatic parameters, partially used reduced-old data for the period (1969 - 1991) was enabling their comparison. In the considered area, meteorological measurements are made only in Berane and Plav and are based on those deduced on the state of climate and in the municipality Andrijevica. All climatic data were analyzed using data from the Republic Hydro meteorological Institute in Podgorica.

Starting from the presented settings, observations and conclusions, this study is to provide a contribution to climate research as well as agricultural values north-eastern of Montenegro, for example the municipality of Berane andrijevica and Plav. In this regard we have made an attempt, through the analysis of climatic conditions and influential factors; we separate the three agro climatic regions, which differ among themselves according to the degree of accommodation climatic conditions for agricultural development. Identifying, analyzing and studying climatic conditions for agricultural development, allows more appropriate and easier management of agricultural policy and establishing attitudes toward specific agricultural practices and developments in agriculture north-eastern Montenegro.

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Related Work: Issue of agriculture and its place and importance in economic development can be set in different ways. On this issue in the past and in modern development, there are different views and interpretations. This has certainly created a rich scientific basis necessary for their commitment to further research. Studying in agriculture, many authors have also analyzed and its economic importance. They are the complex natural and economic process looked at from several angles, either directly, or in the analysis of the overall socio-economic trends.

In defining the objective of the paper we have taken the view that current basic agricultural research was mainly oriented to the larger spatial area (the former Yugoslavia, Montenegro) and less in regions or specific areas. This also applies to the north-eastern part of Montenegro, which in this sense, as we know, has not been analyzed with modern complex agro climatic zoning.

With investigations pertaining to the area had been considered more fragmented character, as was done in the other analysis, or were limited in their scope to only some aspects of agriculture (theoretical basis of agriculture in economic development, changing socio - economic structure of agricultural population, productive potential of agriculture, the structure of land use, changes in ownership structure, production and economic characteristics of farms, the development of commodity production in the country, the income of individual farms and the like). This has certainly created a rich scientific basis necessary for their commitment to further research.

In assessing the climate for agricultural production as the studied area, we were faced with a difficulty that we could not fully remove. It derives from the fact that the value judgments of climate elements in the north-eastern part of Montenegro, determined by narrow data base and lack of measurement of individual climate elements (air humidity, cloudiness, winds), for a longer period of time. This circumstance will not significantly affect the validity of the conclusions, as we found them. Therefore, in view of future climate conditions were necessary for agricultural production in the first place to define temperatures and precipitation. In this sense, the length of the growing season, length frost period, heat sums and amount of rainfall in the growing season and hydrothermal coefficient, were in fact the climate characteristics, relevant to the development of agricultural production in this part of north-eastern Montenegro.

Searching sources of information, literature and the Internet, found the descriptions of similar studies and studies on climate as the value of agricultural regions in the former Yugoslavia and developed European regions. Numerous studies have posed and successfully deal with issues about the importance of climatic conditions for agricultural development, with the research using different methodologies. Far would lead us listing of such research, therefore, in this paper we limit only to the research carried out in Montenegro and related agricultural north-eastern of Montenegro, the example of the municipality of Berane andrijevica and Plav.

Lutovac [2] addressed the natural, social and economic conditions Ivangrad (Berane) basin. The author analyzes and climatic characteristics of the municipality of Berane. Analysis of climatic factors and elements and their comparison and establishes its value for agriculture of the municipality of Berane.

Obuljen [3] indicated very pronounced climatic extremes. Specifically, a narrow coastal band of Montenegro is the Adriatic variant of Mediterranean climate. Area of the old Montenegrin karsts area is heavily influenced by the mountain climate. Skadar Lake basin with Zeta and hills up to about 600 m above sea level is characterized by a modified Mediterranean climate. Area of high limestone mountains and the surface to about 1700 m above sea level has typical alpine climate. North east region which includes the space considered, characterized by a continental-mountainous climate.

Marović [4] deals with the livestock in Montenegro in the period 1860-1953. The author points out that the most important agricultural farming activities on farms in Montenegro. The main factor influencing the orientation of this production is the structure of agricultural holdings of land and the way they are exploited. In addition to the analysis of livestock in this part of the paper, the author points out the natural features that are suitable for development of livestock production.

Group authors [5] deal with measures of accelerated development of underdeveloped municipalities in Montenegro. The results suggested the extent to which agriculture will serve as the basis for faster development of the overall economy, pointing to the climatic characteristics. The article also cites social factors not suspicious importance for economic development and transformation of agriculture in Montenegro in modern forms of work. Of course, the text displays and technical - technological base of agriculture.

Group authors [5] give a projection of agricultural development in Montenegro for the period 1976-1985. Presented research, developed a framework for agriculture development, citing the effects of natural conditions, the subsequent socio - economic trends, it is extremely

important from the standpoint of scientific knowledge for the proper conduct of all social actions and measures of overall agricultural policy.

Kalezić [7] pointed to the structural changes in the Montenegrin village of the twentieth century. U essence, the work seems a modest attempt to be based on socio - economic trends and influential factors, pointed to certain laws in these developments and the prospects related to agricultural development issues in the Montenegrin village.

Ražnatović [8] deals with measures to promote agriculture in Montenegro and believes that, from the construction of rural infrastructure, improving agricultural extension services and preserving and improving land, as the basic factors of agricultural production depends on the further development of agriculture. Also the author emphasizes the potential opportunities of agricultural development and emphasizes that in the present circumstances it is illusory to expect the farmers to become producers of commodities, bearing in mind the problems in providing basic infrastructure changes, inadequate organization of advisory and veterinary services and insufficient use of agricultural land and presence of inadequate protection.

Group authors [9] pointed to the social problems of the Montenegrin village and the current problems in agriculture. It is therefore necessary in the opinion of the author, take measures to promote agricultural production and placement, reconstruction and strengthening of rural infrastructure, development and promotion of rural areas, environmental protection and rural areas, development and promotion of organic agriculture. That is, all that life in the country and engaging in agriculture do not only worthy of a modern man, but also attractive, so that the rural areas of Montenegro would not provide an example of depopulated areas.

Group authors [10] pointed to the possibility of development of a specific commodity production in Montenegro and its adjustment to modern conditions. The authors emphasize that agricultural land has the highest economic value, but warn that no matter how much potential agricultural land were large; they are not unlimited and inexhaustible. Therefore, their use must be planned and rational. More so because in terms of agricultural land and premises considered, is facing four major problems: the extensive land use with extensive planting structure, the relatively small size of the possession of private households (with an average of about three hectares), reduced input of organic matter and low to use organic fertilizers, especially manure and soil degradation.

Đerković [11] pointed to a strategy of agricultural development in regional development. Analyzed in great detail and natural, climatic conditions for agricultural development in Montenegro. From the point of agro climatic zoning observed that, with the altitude significantly deteriorate the characteristics of climatic regions.

Bulatovic [12] presented models of livestock production on family farms of the northern part of Montenegro. In analyzing these phenomena, the author points out the effects of size of estate as an essential condition for income on the family farm.

Rajović [13] addressed the geographic basis of economic development in the Upper Polimlje. Based on the properties of terrain, climate and hydrological conditions, soil types, the representation is singled out, three relatively homogeneous regions, the economic development of the Upper Polimlje. Results showed that the economy, including agriculture, is in agreement with the available natural conditions.

Despotović *et al.* [15] deal with natural conditions and manner of use of agricultural land, as determinable by them affects the abundance, structure and intensity of cultivation of certain types of livestock. High share of meadows and pastures has caused to cattle and sheep are major types of livestock. On the other hand, modest arable land, unable greater presence of pigs. In the future the authors, it is possible to increase livestock production by increasing the number of cattle on production per head, with the help of certain institutional technical - technological and organizational - economic solutions.

Stanković [16] deals with the issue of agricultural and food industry in Serbia and Montenegro. The above mentioned sectors of domestic economy at the same time exercise and increase their exports and imports, but with the ever present trade deficit in foreign trade, which is characteristic of almost all countries in the transition period. As agriculture and food industry has export potential, it is expected that these resources are in the future to fully valorise.

Birovljev [17] pointed out that family farming has a very important role in agriculture. Many years of family farms were and still are the real prospects for development. All government investment and the benefits were reserved for state farms, general agricultural cooperatives. The social sector is usually more efficient and more technologically advanced than the private sector.

Radmanović and Potrebić [17] indicated that over the past few decades, agricultural policy of the Federal Republic of Yugoslavia, that is Serbia and Montenegro,

was basically compatible with the agricultural policy of the European Union, for the development of productivity, income increase, stabilizing the market and consumer protection. However, the results are not as in the European Union, primarily due to low budgetary support to agriculture development. The paper presents parameters to illustrate the lag, but exact understanding, need further and more comprehensive analysis, including the parity price, income and in particular, costs of production.

Despotović *et al.* [18] indicated that in specific areas and, together for the development of agriculture, animal husbandry in the scope and value of production takes first place. Particular importance is that livestock, which utilizes the less productive land - pastures and meadows, which dominate the total agricultural land. This paper presents the status of cattle and sheep in the mountain - the mountain area of Montenegro, as well as the possibility of its improvement.

Lutovac [19] showed the framework of agricultural and rural policy, as an important factor in generating economic development strategy of the municipality of Berane. The first follows a general overview, then a short speech about agriculture and the municipality of Berane situation in rural areas. The author stressed that agriculture, though still dominant in rural areas, however, can not provide the comprehensive development of rural areas of the municipality of Berane.

Rajović [20] considered climatic conditions for agricultural development. Climate of this area is temperate continental character. Combining the favourable and limiting factors, outlines three agro climatic regions which differ by level of benefits of climate conditions for the development agricultural. Also, the author makes the process of project development in organic agriculture and emphasizes that its planned implementation can be achieved if it is effectively coordinate the project objectives, through: Establishment of institutions for certification of agricultural products through the establishment of facilities for primary processing of fruits, vegetables, herbs, wild herbs, wild fruits and the revitalization of derelict land and enlargement of agricultural lands.

Prenkić *et al.* [21] provided an analytical overview of statistics of continental and subtropical fruits and perspectives of development of the agricultural sectors in Montenegro in the period (2002-2006). The authors suggest that the limiting factor for fruit production complex and require a meaningful revitalization in terms of introduction in the production of different types the produced new varieties of fruit trees for the northern, central and southern parts of Montenegro.

Ćetković [22] analyzed the possibility of primary grain production in Montenegro. The author notes that in the mountain region of Montenegro, there are favourable climatic conditions for growing small grains. Specifically, the mountainous region has around 50,000 ha of medium deep and shallow soil on level plateaus and gentler slopes, which the rational fertilization and reclamation of natural grasslands can provide high yields of grass and forage crops and considerable areas are suitable for spring wheat and can be mechanized processing.

Koprivica *et al.* [23] suggest that the mountainous north-eastern part of Montenegro is dominated by livestock production, which predominantly takes place on family farms. Crop production is organized in the function of livestock and the goal is to get as much feed produced on the farm. Improvement in feed production and require better equipment appropriate agricultural mechanization.

In this article we will deal with the tourist aspects of climate, given that the topic was the subject of many authors. Among them this time apostrophized Kne_ević [24], Kasalica [25], Kićović [26], Kasalica and Stanković [27], Nikolić [28].

In general, the theoretical aspects of agriculture have dealt with many researchers, but not specifically agro terms of the north-eastern part of Montenegro, but several studies have focused on different fields of interest: Projections of agricultural development [5,6,8-10,14], structural changes in agriculture [7,14,15,21], agricultural production [4,12,16,18,22,23] evaluation of natural conditions for economic development (agriculture) [2,11,13].

Specific study of climate in Montenegro is engaged in the monograph publication Obuljen 1962nd. The author notes that the air element of recognition and zones phenomena, coastal, continental and mountainous regions of Montenegro, as well as different plant communities. And thanks to the climate, many places in Montenegro, has been developed in the familiar and easy recognizable agricultural and tourist centres. The author states that the north-eastern region of Montenegro, which include the considered space, characterized by continental-mountainous climate with long, strong and snowy winters, late spring and early autumn frosts. Thermal crops are different, depending on the altitude height and exposure, but areas up to 1000 m above sea level, m ay be characterized as favourable for growing all

kinds of continental plants. Mean annual precipitation ranges between 8°C and 10°C, the mean duration of the growing season 160 to 180 days and winter frosts reaching up to - 30°C. Continental character of this area gives the highest average mode rainfall. U annual amount varies between 700 mm and 1000 mm, but they are spaced evenly throughout the year, which is particularly favourable for agriculture. Forward the data shown [3] relating to the north-eastern of Montenegro, which includes not only the Municipality of Berane andrijevica and Plav, but also of Bijelo Polje and Ro_aje. From the aspect of agricultural development Rajović [20] examined the agro climatic conditions of the studied area, which certainly makes a modest contribution to the knowledge of agricultural issues, so we have it as such and in our research use.

Methodology: The core of the methodological procedure used in this study makes the geographic (spatial) method, which included the northeastern region of Montenegro, whose composition includes municipalities: Berane andrijevica and Plav. To collect data related to the main climatic factors of development, we used the statistical method. Comparative method allowed us to under agro-climatic conditions for agricultural development we highlight three agro-climatic regions which differ by degree of convenience climate for agricultural development. Permeated through the entire text of the method and integrity, thanks to which we were able to identify, define and assess potential climate limits agricultural development. The scientific explanation of terms, by two methods as follows: analytical and synthetic. Analytical methods are discussed agro-climatic certain dimensions of the research topic. Since work has essentially synthetic character, the results published in the international literature. Among them this opportunity to emphasize this: Hutchinson *et al.* [29], Bouma [30], Kleshchenko [31], Qian *et al.* [32].

Analysis of Results and Their Interpretations: Climate has a major impact on agricultural production and it can not be significantly affected, because it occurs as a dominant factor of production. Climatic conditions for agricultural production have been defined primarily temperature and precipitation. In this sense, the length of the growing season, length of time without frost, heat sums and the amount of rainfall in the growing season and hydrothermal coefficient, are in fact climate characteristics, relevant to the development of agricultural production.

For agriculture is important cardinal point temperature: the temperature minimum, optimum and maximum. The minimum temperature below and above the maximum, the physiological processes of plants cease to exist, most are at the optimum temperature. Since, on physiological processes in plants, all temperatures below 0°C is considered negative and above 0°C positive. How division of cells in the plant, stops at 5°C, this temperature we consider the biological temperature minimum. Effective temperature of the active temperature and reduced by the value of biological temperature minimum.

Over the years, the temperature of air in the subject area, has a negative average monthly temperature in January (-1.9°C Berane, Plav -2.2°C) or in December (Plav - 0.7°C). Low temperatures are not favourable for the plants, primarily due to cessation of active vegetation. At temperatures below 0°C, terminated active vegetation, thermal crests offer unusually plants die and turn into hide crests offer unusually stage sleep (crypto vegetation). Types of winter due to the gradual adjustment may file a low temperature (tempering) Alternation of warm and cold days in winter, negative impact on crops. If the days are warm, the plant begins to breathe intensive, consumption of sugar increases, awakens from hibernation - screen, activated by its metabolism and in case of low temperature, it usually dies. In winter, low temperatures cause freezing of the surface layer of soil, but favour some kinds of tubers and bulbous - the period of stratification. Resistance to low temperature depends on inherited properties, annealing and balanced nutrition, cultivation of resistant hybrids and varieties, quality of soil tillage, drainage and parcels, wrapping wrap or organic materials, piling and growing in protected areas (Hayami, 1971). Air temperature in the subject region from winter and spring months, says summer is rapidly increasing. The highest values reached in July (17.0°C Berane, Plav, 15.8°C), which together with august (16.2°C Berane, Plav, 15.8°C), the hottest of the year. The mean annual temperature in the considered region, ranging from 8.0° C in Berane up to 7.3°C in Plav.

Knowing the absolute minimum and maximum air temperature is very important for agriculture [34]. Absolute maximum air temperatures are between 31.3°C (Plav) and 32.6°C (Berane). The amplitude of the absolute minimum temperature in Berane is -19.4°C while in the Blue -20.7°C. The amplitude of the absolute maximum (July-Berane 32.6° C) and absolute minimum (January: Plav -20.7°C) are 53.3°C, which indicates a very strong influence on the formation of continental climate conditions in the considered region.

Table 1: Mean monthly and annual temperature for the period 1969-1991 years

Station	Elevation	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	MAT	AMP
Berane	670	-1,9	1,3	3,6	8,0	12,2	14,8	17,0	16,2	13,8	8,6	3,2	0,1	8,0	18,9
Plav	908	-2,2	0,3	3,4	6,8	11,3	14,7	15,8	15,8	11,9	8,2	3,1	-0,7	7,3	18,0

Source: Republic Hydro meteorological Service of Montenegro, Meteorological year olds (respective year).

Table 2: Absolute maximum and absolute minimum air temperatures of Plav and Berane for the period 1969-1991 years

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Years
						PLAV							
MAX	11,9	16,7	20,4	28,1	24,2	29,3	31,1	31,3	27,1	24,4	21,0	13,8	31,3
MIN	-20,7	-18,4	-16,1	-6,2	-1,9	1,1	2,4	3,2	-4,7	-5,9	-17,7	-19,8	-20,7
						BERANE							
MAX	12,8	17,2	21,1	23,2	25,5	307	32,6	31,6	28,5	24,6	21,1	14,0	32,6
MIN	-19,4	-15,6	-12,6	-3,7	-1,5	1,2	3,4	3,3	-2,9	-5,0	-15,1	-19,0	-19,4

Source: Republic Hydro meteorological Service of Montenegro, Meteorological year olds (respective year).

Table 3: Middle start dates, end and duration of periods with mean daily air temperature ≥ 5°C, for the period 1969 - 1991 years and the corresponding vertical gradients

Station	Elevation	Over 5°C Home	Over 10°C Completion	Over 15°C Duration
Berane	670	30.IV	08.X	162
Plav	908	06.V	30.IX	146
Vertical gradient of 100 m		+ 2,5 days	- 3,4 days	- 6,7 days
	1000	09.V	26.IX	140
	1100	12.V	22.IX	133
	1200	15.V	18.IX	126
	1300	18.V	14.IX	119
	1400	21.V	10.IX	112
	1500	24.V	06.IX	105
	1600	27.V	02.IX	98
	1700	30.V	29.VIII	91
	1800	02.V	25.VIII	84
	1900	05.V	21.VIII	77
	2000	08.V	17.VIII	70

Table 4: Middle start dates, end and duration of periods with mean daily air temperature = 10° C, for the period 1969 - 1991 years and the corresponding vertical gradients

Station	Elevation	Over 5°C Home	Over 10°C Completion	Over 15°C Duration
Berane	670	26.III	05.XI	223
Plav	908	01.IV	03.XI	215
Vertical gradient of 100 m		+ 2,1 days	- 0,8 days	- 3,13 days
	1000	03.IV	02.X	212
	1100	05.IV	01.X	209
	1200	07.IV	31.X	206
	1300	09.IV	30.X	203
	1400	11.IV	29.X	200
	1500	13.IV	28.X	197
	1600	15.IV	27.X	194
	1700	17.IV	26.X	191
	1800	19.IV	25.X	188
	1900	21.IV	24.X	185
	2000	23.IV	23.X	182

Table 5: Middle start dates, end and duration of periods with mean daily air temperature = 15° C, for the period 1969 - 1991 years and the corresponding vertical gradients

Station	Elevation	Over 5°C Home	Over 10°C Completion	Over 15°C Duration
Berane	670	22.VI	27.VIII	66
Plav	908	04.VII	19.VIII	44
Vertical gradient of 100 m		+ 5,0 days	- 3,4 days	- 9,2 days
	1000	09.VII	16.VIII	36
	1100	14.VII	11.VIII	27
	1200	19.VII	07.VIII	18
	1300	24.VII	03.VIII	9

Table 6: Mean monthly and annual temperature sum in Plav and Berane for the period 1969 - 1991 years

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Years
Plav	-68,2	-8,4	105,4	204,0	350,3	441,0	489,8	489,8	357,0	254,2	93,0	-21,7	2686,2
Berane	-58,9	36,4	111,6	240,0	378,2	330,0	527,0	502,2	414,0	266,6	96,0	-3,1	2950,0

Source: Republic Hydro meteorological Service of Montenegro, Meteorological year olds (respective year).

Table 7: Temperature sum, with temperature ≥5° C, ≥10° C and ≥15° C for specific altitudes

Station	Elevation	The annual sum of temperatures	Σ T≥5°C	ΣT ≥10°C	ΣT≥15°C
Berane	670	2950,0	2820,8	2349,0	1061,0
Plav	908	2682,2	2549,1	2060,3	696,6
Vertical gradient of 100 m		-110,8	-114,1	-121,3	-155,2
	1000	2578,7	2444,3	1948,7	548,8
	1100	2467,9	2330,2	1827,4	393,6
	1200	2357,1	2216,1	1706,1	238,4
	1300	2246,3	2102,0	1584,8	83,2
	1400	2135,5	1987,9	1463,5	
	1500	2024,7	1873,8	1342,2	
	1600	1913,9	1759,7	1220,9	
	1700	1803,1	1645,6	1099,6	
	1800	1692,3	1531,5	978,3	
	1900	1581,5	1417,4	857,0	
	2000	1470,7	1303,3	735,7	

Table 8: Bioclimatic sum of air temperature for each culture, the Otorepec, Wolf, Dimitrovskij

Culture	Earliness	Bioclimatic Sum	Culture	Bioclimatic Sum
Spring wheat	Early	1350 - 1550	Spring wheat	1300 - 1700
Spring wheat	Middle Early	1650 - 1750		
Winter wheat	Early	1500	Winter wheat	1450
Spring oat	Early	1350 - 1550	Oats	1300 - 1500
Winter rye	Early	1350	Winter rye	1350
Winter barley	Early	1300	Barley	1200 - 1400
Corn	Medium maturity	2350 - 2650	Corn	2100 - 2900
Corn	Medium maturity	2750 - 3150	Millet	1300 - 1700
Clover			Member of the fibber	950 - 1300
1. swath	Very early	1100	Flash oil	1400 - 1500
2. clippings	Medium early	1700	Sunflower	1600 - 2300
Alfalfa			Soy	1800 - 3000
1. swath	Wound	900	Millet	2200 - 2800
2. clippings	Wound	1800	potato	1200 - 1800
Potato	Wound	1400 - 2000	Cotton	2900 - 4000
			Rice	2000 - 3200
			Sugar beet	2000 - 3000

The most harmful effect of high temperature is due to the large increase in evaporation transpiration, with the plant irreversible phenomena occurring in the structure and metabolism of plants (coagulation of protoplasm and dehydration), comes to the destruction of chlorophyll, increased transpiration and respiration, leading to accelerated aging - forced ripening. This phenomenon is particularly well known in small grains as a "heat wave", when air temperature reaches a value of 33°C (July Berane ˜ 32.6° C, August 31.6° C; July Plav ˜ 31.1°C, August 31, 3°C), with low relative humidity, can be within a few hours break in the vegetation of wheat waxy ripening stage and cause leanness and decline in grain quality and yield. In summer (July and August), the mean monthly relative humidity in the afternoon (14 hours) Berane is below 45% and the Plav 46%. Such a small value of saturation of air with water steam, it has adverse effects on agricultural crops, especially row crops. In contrast, low values of relative humidity in April from 62% (Plav) to 63% (Berane), increase the risk of late spring frosts. However, high temperatures can be useful in agriculture is limited due to the drying of wet land and training for field work and useful ripening and drying crops.

Growing season is different for each culture. Its length is determined by the biological minimum temperature required for particular stages of plant growth. For small grains, grasses and some industrial crops growing season starts with the daily mean temperature ≥ 5°C, maize, central European fruit and vegetable crops with a mean daily temperature ≥ 10°C and for thermal crests offer unusually plants (a kind of vegetable) growing season was determined by high daily temperatures ≥ 15°C [35]. Period with temperatures ≥ 5°C at both stations began in the period from 26 March in Berane and 01 April in the Blue and lasts from 215 to 223 days i.e. ends in early November (November 05 in Berane and Plav, 03 November). From the time difference and the performance period ending the period with average daily temperature ≥ 5°C at stations in Plav and Berane, it is possible to determine the appropriate vertical gradients.

According to the values of vertical gradients at altitudes about 670 m growing season begins in late march and lasts until the first half of November, i.e. about 223 days. Above a height of 670 m is considerably shortened, but still up to a height of 1700 m over the last six months of the year. Hence, in the past at this height was grown primarily spring wheat. In Table 3 the characteristics of this period to up to 2000 m. Vegetation period with average daily temperature ≥ 5°C in Berane lasts 223 days, 215 days in the Plav. Length of growing period with mean daily air temperature (hereinafter referred to as Td) ≥ 5°C is reduced to every 100 feet for about three days. At altitudes over 2000 m vegetation period is less than five months.

Period with mean daily temperatures over 10°C begins at the north-eastern part of Montenegro 30.IV in Berane and 06.V in Plav and lasts until 30.IX in Plav and 08.X in Berane, it is 146 days in the Plav and 162 days in Berane. With increasing altitude length of growing season with Td ≥ 10°C is reduced. With the help of the vertical gradient, we calculated that at an altitude of 1000 feet, this period began in the second decade of May and lasts until the last decade September and 140 days. At a height of 1200 m on start quite late (mid-May) and lasts until mid-September (a total of 126 days). With the shortening of the growing season narrows the choice of crops. Specifically, shortening the growing season is very adverse effects on ripening crops that have higher demand for heat (e.g. corn, beans, etc.). Lower hypsometric zones where they and other agro-climatic conditions are favourable growing period Td ≥ 10° C, takes relatively long and its length does not represent a significant constraint to agricultural production (Table 4).

Performances with the duration of the period Td ≥ 15°C are especially important for some vegetable crops grown in the municipalities of Berane, Plav and Andrijevica such as peppers, tomatoes, cabbage, etc. According to Table 4 he begins early in the second decade of June and lasts until the end of august, which is about 66 days. At a height of 1000 m period starts in the first half of July (09.VII) and ends on 16 VIII, i.e. lasts 36 days.

Temperature sums, taken as the sum of mean daily temperature in a period of time, are a main indicator of the thermal features of growing profitable crops. In the table shows average monthly and annual temperature sum for the station in Berane and Plav. Total annual temperature sum in Berane 2950.0°C in the Plav 2686.2°C. However, for assessing the climatic conditions it is necessary to calculate the temperature sum during growing periods. for the period with average daily temperature ≥ 5° C, ≥ 10° C for a period ≥ 15°C (Table 7).

Temperature sum during the Td ≥ 5°C amounts in Berane 2820.8°C, respectively during this period accumulates to 95.6% in Berane, Plav, 94.9% in the total annual amount. In the period from Td ≥ 10°C temperature sums of the amounts of 2349.0°C (Berane) and 2060.3°C (Plav), which is 79.6% (Berane) and 76.7% (Plav) of the total annual amount for these two stations. In the period Td ≥ 15°C temperature sums are 1061°C (Berane -35.9% of the total) and 691.6°C (Plav -25.7% of the total).

In order to properly evaluate the temperature sum necessary to take into account the amount of bioclimatic air temperature of some crops (Table 8). Thus, for example for early maturing cultivars required temperature sum of 1500°C, the early varieties of winter barley in 1300°C, but for the medium maturity corn from 2350 to 2650°C and even corn Late middle stature 2750-3150° C. On the other hand for the early varieties of fodder crops is necessary along with clover 1700° C, alfalfa 1800°C, early potatoes from 1400 to 2000° C and so on. [36][1].

Mentioned values but indicate the upper limit of possibilities of growing some crops. If the value of the sum of temperature over 10°C compared with the values of bioclimatic sum (Table 7), indicate that the upper limit of possibilities of growing medium stature corn on about 500 m above sea level, soybeans at about 1400 meters above sea level, however, if we take into account the biological minimums required for each phase of development shows that the upper limit of profitable cultivation of agricultural crops to a lower altitude [35].

In terms of climate that prevails in the north-eastern part of Montenegro, the growth and development of agricultural crops is significant and the length without frost period since the late spring and early autumn frosts can affect yield. Mid -spring frost date in late April as Berane and Plav. In accordance with the division Gorcberga both meteorological stations are located in the "zone of zero difference" where the growing season with Td ≥ 10° C and without frost periods approximately equal because the difference varies in the range of + - 5 to 10 days. In the area depression hills and the edge is the "zone of positive difference", where the frosts end before the period with temperatures above 10°C. Thus, the probability of occurrence of late and early frosts during the growing season with Td> 10°C was higher in the alluvial plains and low river terraces Berane andrijeviaa, Polimlje, but the depression of hills and the edge [20].

For growth and development of agricultural plant are significant and extreme dates, last spring and first fall frost. According to data from the RHMS of Montenegro in the period 1969-1991, extreme late frost date is recorded about 15.VI Berane, Plav about 10.V and early autumn in Berane about 02.X and Plav about 29. IX. Late spring frosts in varying degrees of compromise of a culture. Suffer the most fruit, which was then located in flowering. Bearing in mind the extreme dates of frost occurrence, without frost period is visibly reduced. It takes about 141 in Berane, Plav and about 124 days.

From the point of winter and perennial crops are highly significant and extremely low temperatures during the winter period the apparent mode of culture. The extremely high temperature (38.6°C Berane, Plav 37.5°C), transpiration increases and hamper normal water supply. Number of days with temperatures exceeding 25°C in summer (June-September) ranged from 46 days in the Plavu up to 55 days in Berane. Extremely low temperatures (Berane - 25.7°C, Plav- 28.7°C) can damage winter crops and perennial crops if a longer life. Annual precipitation and their distribution by months provide rough idea of the provision to crop moisture. From the point of agro climatic evaluation in this regard are accurate indicators of rainfall in the growing season.

For the growing period in this analysis is tentatively taken the period from April to September. Maximum secretion deposits on measuring stations in November or January. Amount excreted in the growing season precipitation increases with altitude ranging from 395 mm in Berane, 485 mm in Andrijevica, 185 mm in the Plav, 519 mm in Gusinje to 659 mm in Vusanje. In the first three months (April - June) excreted about 55% of the total precipitation in vegetation period. Potential insight into the deficit of atmospheric moisture provides Seljaninov hydrothermal coefficient [37]. Namely, between precipitation in the growing season and temperature sum during the period with temperatures above 10°C, it follows that the value of this coefficient in Berane about 0.9, 1.3 and Plav. However, the value of hydrothermal coefficient for each month during the growing season show that the greatest deficit of atmospheric moisture occurs both in Berane, Plav and in the months of July and august. This means that the plants in the basins is necessary to compensate the deficit of atmospheric moisture during July and august.

An important factor in agriculture as rainfall: rain, snow, city and dew. In the rain it is important to know the intensity and extent by the amount that falls in unit time. The intensity of rain more, it uses less land and the risk of erosion is greater. According to the municipal secretariat for economic affairs, in the subject area, of the total agricultural area (68,050 ha) and forest land (62,432 ha), 88,322 ha have been affected by erosion. It is observed in the area particularly evident in the basin of Lima and its flow: Ljuca, Mosquito, Velicka, Murinska river and crusting Zlorecica... For agriculture are the most silent rain, low intensity, when 95% of water absorbed by the land, for a period of 6 hours. Rain is bad, if the soil is

[1] Bioclimatic of heat for the same culture differ in particular from the time when the mass started to get artificially diverse variety of cultures with different time of ripening, therefore the individual authors for information on bioclimatic amounts vary.

already saturated with water, making it muddy which hinders agricultural work. Strong (heavy) rain, especially if the wind carries them, causing lodging of herbaceous and woody plants fracture. While, warm rain promote vegetation and life in the soil and cold and long hampered by vegetation and biological processes. High intensity rains (rains), causing strong erosion processes in steep terrain and on flat causing water logging in Micro depressions. So Prosjane between Dapsića and Zagrađe, then end at Gradac and Bjelovac in the village of Buèa, a breakdown of a dense network of streams, gullies, ravines and el. [2].

Crop production, snow cover has a positive and a negative role. Beneficial effect snow is reflected in the fact that mainly occurs in micro-thermal period, as a thermal insulator and keeps the winter crops, freezing. In addition, the source of moisture for the soil in early spring months, in areas with less rainfall, with higher amounts during the year falls in the form of snow. In the winter half year precipitation normally excreted in the form of snow. According to, the atlas of climate Yugoslavia (Meteorological Service of the Socialist Federal Republic of Yugoslavia, 1968) in snow cover in the river valleys reserves from mid-December to mid-march, at a height of up to 800 m above sea level since mid-November to early April and the highest mountain peaks from the beginning November to mid-April. Therefore, snow is in depression plane retains about 40 days, depression and peripheral hills depending on elevation 40 - 70 days and the mountain rim of 90 days. Mean maximum height of snow cover depending on the altitude ranges from 20 cm in depression planes to over 90 cm on the highest mountain peaks. Effect of snow cover is reflected in several ways. Early snow cover can enhance the spread of the disease, with some winter crops, loss of crops due to the prevention of photosynthesis, creating ice sheet, which causes preventing the flow of oxygen. Wet and heavy snow can cause choking crops and long retention snow, replies timely preparation of land for planting and other agro-technical interventions. Average number of days with snow in the subject area ranges from 32.1 to 43.8 in Plavu in Berane. The highest average number of days with snow has the Blue in January (8.6 days) and December (8.4 days) and Berane have 12.8 days (January) and 12.5 days (December). Dew is condensed water steam, the surface soil and in certain circumstances can be used as a source of water in plants. In the temperate continental shelf, as is discussed, the dew does not play a significant role in supplying plants with water, although in the dry season plants can help in overcoming the critical period of lack of moisture. According to research in Germany, in a warm part of the frost-free, monthly volume rose converted to rainfall, amounts to 1.21 - 2.46 mm.

Relative humidity is important for plant life. The mean annual humidity is 68% in the Plav and 67% in Berane. In summer (July and august), the mean monthly relative humidity in the afternoon (14 h) in Berane is below 45% in Plav below 46%. Such a small value of saturation of air with water steam, it has adverse effects on agricultural crops, especially row crops. In contrast, low values of relative humidity in April from 62% (Plav) to 63% (Berane) increase the risk of late spring frosts.

Cloudiness for the investigated area has an average annual value, the coverage of 8.1 / 10 above the Plav and 9.0 / 10 above Berane. The lowest average sky coverage of 3.4/10 in July in the Plav, in the same month in Berane with the higher and amounts to 4.4 /10. Increased cloudiness in the winter months (from 10.2 / 10 at the Plav to 12, 4 / 10 in Berane), alleviates daily fluctuations in temperature, which has a positive impact on winter crops, nursery plants in greenhouses and continuous culture (fruit).

To the values of the annual frequency of wind direction and quiet, with the highest frequency of silence - 410 parts per thousand (Berane), 520 parts per thousand (Plav). Meridian direction of the Lima valley from the south to the north caused the dominance of the north wind in Berane 140 per thousand, in the southern Plav 140 parts per thousand. Winds from the north direction reduce winter air temperature and thus jeopardize the production of seedlings in greenhouses and winter crops. From the aspect of agricultural production have a negative effect and winds from the south. In fact, during the growing season dry land and increase the transpiration of agricultural crops.

Air is one of the elements of climate and the living organism is its composition and movement of a significant ecological factor. The air in the north-eastern part of Montenegro is clean, especially outside urban areas Berane andrijevica and Plav. The estimates of completed by the Institute of Public Health of Montenegro, Podgorica (1995) observed in the air space in their composition is a first class quality, with the exception of urban settlements Berane, which belongs to another class of quality (after cessation of operations of the factory of pulp and paper). According to Komljenović [38] in the air has the highest nitrogen (gaseous nitrogen for plants unusable). Agricultural nitrogen from the atmosphere is important, because it is associated soil micro organisms (nitrogen fixation). After nitrogen, the air contains the

most oxygen. It is found in abundance for all the oxidation processes, while the amount of carbon dioxide in the air is constantly changing. In winter, it has more and flies less, on the morning of carbon dioxide content is higher and lower at night. Carbon dioxide has more in woods than on the pitch, the more dense the crop, but in rarer. In crop production, it is difficult to increase the amount of carbon dioxide, although the stimulation of soil aeration can be achieved by increasing the amount of ground level air.

Combination of favourable climatic conditions and constraints for agricultural development in the north-eastern part of Montenegro emphasize three agro climatic conditions which differ by level of service climate for agricultural development (Map 1). From the point of agro climatic zoning it is important to note that with the altitude deteriorating characteristics of most of the analyzed characteristics.

Low Mountain agro climatic conditions extend area of hill and mountain and valley areas at a height 645 - 1100 m. In this agro climatic regions are as follows:

Agro-climatic area of the alluvial plain rivers, river terraces, lake sediments Berane andrijevica and Polimlje valley (I area - A) has the most favourable conditions for intensive agricultural production. The length of the growing season with Td ≥ 10°C over 150 days and the sum of active temperatures with Td ≥ 10°C are over 2100°C, allowing cultivation of various vegetable crops. However, low values of relative humidity in However, low values of relative humidity in April (about 62 %) increases the risk of spring frost and dew and make these areas less favourable for fruit production. Adverse climatic characteristics are associated with a small amount of rainfall during July and August. In summer (July and August) monthly mean relative humidity in the afternoon (14 h) was below 45 %. Such a small value of saturation of air with water steam, it has adverse effects on agricultural crops.

However, shelterbelts belts could increase the relative humidity, because it increases the productive evaporation. In contrast, in warmer areas, tillage, fertilization, irrigation increases the vigour of crops, which requires lowering the temperature for 2 - 3°. Irrigation of crops increases the heat emission of land, which significantly lowers the temperature level. On the plots without irrigation on evaporation of moisture is consumed by 30 - 40 % of solar energy received and on irrigated 80 - 90%. Drained soils were warmer, without frost period is longer on the drainage areas for 5 - 10 days and treatment in the spring begins 10-15 days earlier. Application of mulch reduces erosion, prevents the formation of crust, reduces the size of evaporation transpiration and reduces the incidence of weeds, increasing or decreasing soil temperature [38].

According to the natural advantages of the alluvial plain rivers and river terraces are suitable for intensive agriculture, especially agricultural production. In contrast, in warmer areas, tillage, fertilization with irrigation increases the steam of crop land due to glare, which requires lowering the temperature for 2 - 3°C. Irrigation of crops increases the heat emission of land, which significantly lowers the temperature level. On the plots without irrigation on evaporation of moisture is consumed by 30 - 40% received solar energy and on irrigated 80 - 90 %. Drained soils were warmer, frost free period is longer on the drainage areas for 5 - 10 days and treatment in the spring begins 10-15 days earlier. Application of mulch reduces erosion, prevents the formation of crust, reduces the size of evaporation transpiration and reduces the incidence of weeds, increasing or decreasing soil temperature. Chemical defoliation influences the increase in temperature, reducing humidity, increasing the heating area [38].

Agro climatic the area covering Plav - Gusinje valley (I area - B) has similar characteristics as the previous agro climatic the region. The length of the growing season with Td ≥ 10°C over 140 days and the sum of active temperature with Td ≥ 10°C around 1200° C, allowing cultivation of vegetable crops. In summer (July and august) monthly mean relative humidity in the afternoon (14 h) is below 46% and this small value of saturation of air with water steam, it has adverse effects on agricultural crops [13].

Map 1: The area of climatic conditions by level of benefits for the development of agriculture in north-eastern Montenegro, for example the municipality of Berane andrijevica and Plav.

Agro-climatic region of the high-mountain areas of low relief and low high-mountain regions of the relief is up to 1100 m (I area - B). The mean temperature in this the region during the growing season is about 12°C, relative humidity of 68% and the length of the growing season with Td ≥ 10°C for 130 days and the sum of active temperature 1800°C allow the cultivation of certain vegetables. This the region is relatively favourable for agricultural production or for growing orchards and over 1000 m above sea level is mainly woodland (beech-fir forest, oak woods and forests of red and white pine), pastures and meadows, which favours the development of animal husbandry (Rajović, 2005).

Middle Mountain agro climatic area extends over altitudes between 1100 - 1700 m (II area). This area includes the area in which the government sub mountain air and the heat conditions worsened. Period with Td≥ 15°C is from 191 to 209 days and accumulated about 1600 to 2300°C. Period with Td ≥ 10°C takes 91-133 days to accumulate about 1100 - 1800 °C, while the period with Td = 15°C takes 9-27 days to accumulate 83 - 400°C. This region is mostly under grassland and forest vegetation (forests of pine, spruce, beech, oak, fir). This relief unit is suitable for raising livestock. "These are generally steep mountain slopes, covered with thick forests. Are mostly flat terrain meadows while the area under arable land minor (grown mainly potatoes, barley, rye and oats) [11]. Agrotechnics to some extent may affect the regulation of temperature and air and land food regime. So what is peeling, post-harvest stubble in the soil retains 20 to 30 mm of water. The depth of soil treatment for 1 cm decreases in water loss for 2 - 4 mm, because tillage breaks structure land and the ascendant for some time prevents the flow of moisture. Following an earring in cold areas (in what belongs to this region), soil temperature increased 3-5°C, thereby increasing the volume of soil and in this regard and capacity of the soil air, which acts as a thermal insulator.

High Mountain agro district consists of high mountains, ridges and peaks above 1700 m (III area). Above sea level with a period Td ≥ 5°C below the 191 day and accumulate less 1600°C, the period with Td ≥ 10°C below the 191 day and accumulate less than 1600°C, the period with Td ≥ 10°C is below 91 days and accumulates less than 1100°C. This area does not have one day with Td than 15° C. "Represented the mountain pastures with blueberry and juniper tree" [11]. People from this region have almost no awareness of the presence valorisation and its importance and possibilities. In fact, healing juniper has long been known as one of the best known and most-used national and local medicines, which is used to treat many diseases, for indoor and outdoor use: as a diuretic, anti-cold, cough, dropsy, gonorrhoea, asthma, the stomach, sweating, etc.. a view in the form of spirits or in strong brandy for coating and rubbing against the cold, rheumatism and related diseases. Geneva is widely known, as an aromatic brandy (www.moja.flora.com). Protective effects of bilberry stand out in the case of intestinal infections, digestion and the problems with the gall bladder. The high content of anthocyanins in the fruits of blueberries makes a strong bactericide. Blueberry syrup improves visual acuity (ordered in twilight), which is very important for some activities (drivers, pilots, researchers...). In addition to using the fresh (full economic maturity), the fruits can be used in the industry, to obtain juice concentrates, jellies, jams, freezer and obtaining alcoholic beverages (www.tehnologijahrane). Raising the modern blueberry plantations in the subject region is in its infancy, unlike many modern regions in Europe where high-bushy varieties grown greatly.

CONCLUSION

Evaluation of agricultural climate is a complex and important task. Analysis of the climate elements is conditioned by the richness of the data points obtained by systematic measurements and observations of meteorological stations. Value assessment of climate elements in the north-eastern part of Montenegro, is determined by narrow data base and lack of measurement of individual climate elements (air humidity, cloudiness, winds), for a longer period of time. Therefore, the analysis of basic climatic parameters, partially used reduced-old data for the period (1969-1991.), enabling their comparison. Measurements of meteorological parameters are made only in Berane and Plav and according to them we deduced the climate condition in the subject area. All climatic data were analyzed using data from the Republic Hydro meteorological Institute in Podgorica. Analysis of climatic elements and their comparison, it can be determining agriculture value climate in this part of north-eastern Montenegro. In accordance with such a set task, especially processed and analyzed using agro-climatic conditions.

Agro-climatic conditions for agricultural production have been defined primarily temperature and precipitation. The length of the growing season, without frost period, the sum of heat, precipitation and hydrothermal coefficient of climate properties that is relevant to the development of agricultural production in the north-eastern part of Montenegro. From the foregoing, we conclude that this part of north-eastern Montenegro in terms of climate suitable for growing more crops. For small grains, grasses and some industrial crops growing season starts with the high daily temperature ≥ 5°C, for corn, Central European fruit and some vegetable crops with high daily temperatures ≥ 10°C and for thermophilic plants (some types of vegetables), growing season is determined by the average daily temperature ≥ 15°C. From the point of agro climatic zoning in the studied area we highlight three agro climatic regions: low, middle and high mountain agro-climatic region. Most favourable agro-climatic

conditions for intensive agricultural production in the low mountain agro climatic regions has agro the region alluvial plain rivers, river terraces, lake sediments Berane andrijevica and Polimlje valley, has a somewhat lower advantage of Plav-Gusinje valley. Most favourable agro-climatic conditions for intensive agricultural production in the low mountain agro climatic regions has agro the region alluvial plain rivers, river terraces, lake sediments valley Berane andrijevica and Polimlje, has a somewhat lower advantage of valley Plav-Gusinje. Agro-climatic region of the high-mountain areas of low relief and low high-mountain regions of the relief has relatively favourable conditions for agricultural production or for growing orchards. Middle mountain agro-climatic region is largely under grassland and forest vegetation. Flat terrain is mostly under the meadows, while the area under arable land minor (grown mainly potatoes, barley, rye and oats). In the high mountain agro-climatic region are not shown on the Td over 15°C. Represented predominantly mountain pastures with blueberry and juniper.

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