DROUGHT ANALYSIS FOR THE REGION OF NORTH BACKA, SERBIA

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The aim of the research

The aim of this paper is to determine the humidity conditions in the North Backa District by analyzing years-long climate data (1961-2018) and to study the meteorological and agricultural aspects of drought by means of several various indicators..

Materials and methods

Meteorological data (from 1961/62 to 2017/18) for weather station Palic, representing the region of North Backa, were provided by the National Hydrometeorological Service of Serbia. Drought analysis was based on the following climatic parameters: annual, growing season (April-September) and monthly mean air temperature; number of tropical days (Tmax>30^{o}C); annual, growing season and monthly precipitation. The annual data refer to the hydrological year, from October of one year to September of the next year.

Meteorological and agricultural aspects of drought was assessed using following groups of drought indices:

1. Indices based on precipitation data only - The Standardized Precipitation Index: SPI-6 for September 30th, SPI-3 and SPI-2 for August 31th;
2. Indices based on precipitation and temperature data -De Martonne Index;
3.Indices that also include potential evapotranspiration (PET) - Reconnaissance Drought Index (RDI): RDI-6, RDI-3 and RDI-2, Aridity Index(AI) and Climatic Precipitation Deficiency (CPD).

DrinC software was used to calculate SPI and RDI. Other indices were calculated using Microsoft Excel.Drought indices are determined on an annual basis and/or for growing season and summer months. PET for determining CPD was calculated using the FAO method Penman-Monteith, while Thornthwaite method was used to calculate PET for AI and RDI.

Results and discussion

Study results suggest that climatic conditions for agricultural production in North Backa are very variable, deteriorating in the last few decades.

Temperature (Fig.1) and number of tropical days showed positive trends in the last three decades of the studied period.

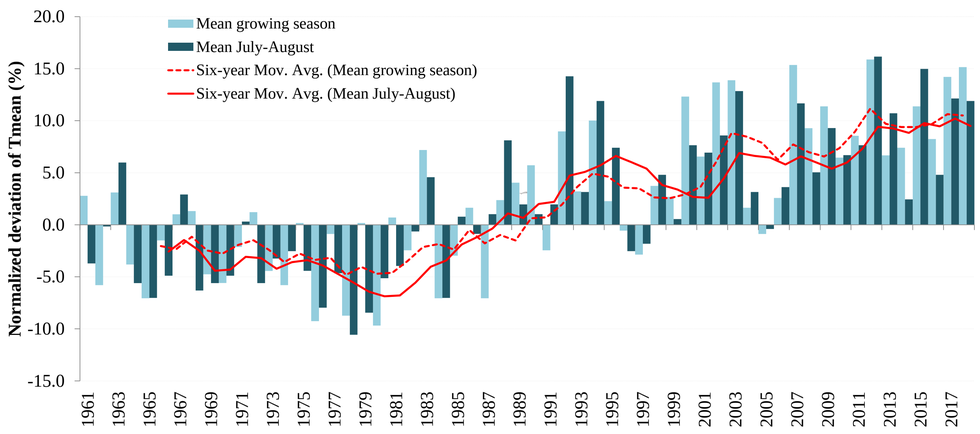

Fig. 1. Mean temperature deviation from the reference period 1971–2000 during the summer period (July-August) and growing season. The red lines represent a six-year moving average for the July-August period (solid line) and growing season (dashed line)

Drought was present in 14% of growing seasons (according to both SPI and RDI) and 16% cases (according to SPI) and 17% (according RDI) during July and August.

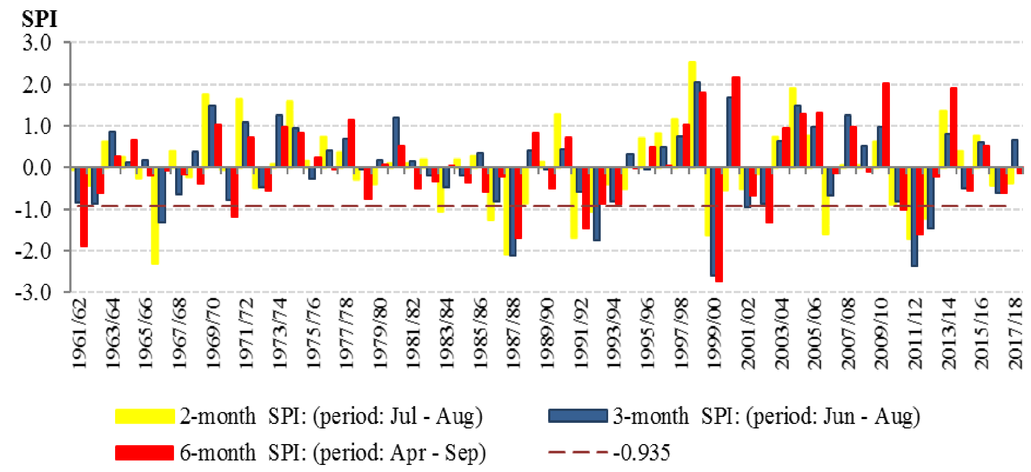

Fig. 2. SPI-6 values for September 30th, SPI-2 and SPI-3 values for August 31th

The average values of the De Martonne's Index (1961-2018) were in the range from 20 to 30 during the complete growing season (Tab.1), which indicates that irrigation is required as an supplementary measure.

Tab. 1. Monthly values of the drought index according to De Martonne (Im)

1961-2018	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Im	44.7	36.3	25.7	23.5	25.7	29.1	23.2	20.4	20.7	21.8	34.5	50.1

De Martonne Index revealed that every second year irrigation was necessary from July through September for all crops except for those very resistant to drought (Tab.2).

Tab. 2. The analysis results of the De Martonne's Index monthly values for July-September

	Im<5	Im=5-10	Im=10-20	Im=20-30	Im>30
Jul	3%	9%	36%	24%	28%
Aug	10%	10%	36%	26%	17%
Sep	10%	14%	28%	31%	17%

The RDI shows similar results as the SPI (Fig. 3).

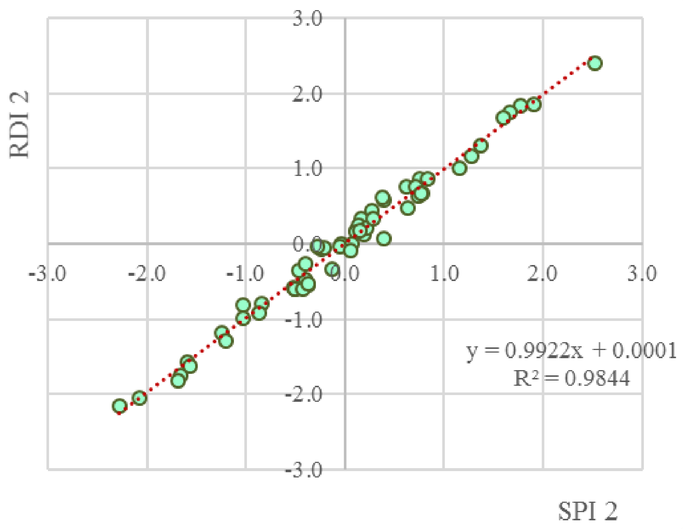

Fig. 3 Relation between RDI-2 and SPI-2 for August 31th for the meteorological station Palic (1961-2018).

The distribution functions (Fig. 4) created for the interval of the growing season and the July-August period show that once in ten years the CPD was 253mm in the July-August period, and 529mm in the complete growing season.

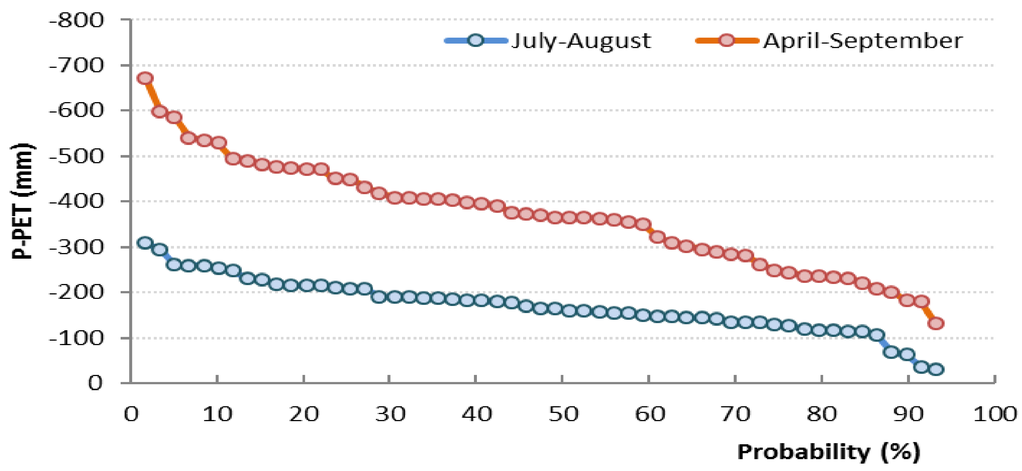

Fig. 4 Distribution function of CPD (mm) for the growing season and the period July-August for meteorological station Palic (1961–2018).

The CPD index (Tab.3) indicated that water shortage was present during the whole growing season (352mm), with the largest water deficit in July (83mm) and August (76mm), which is the period when crops have the largest water requirements.

According to the Aridity Index, the occurance of semi-arid growing season was more frequent in last two decades (every second year) than in the previos period (every third year).

Tab. 3 Monthly values of CPD, calculated on averaged values for the period 1961–2018. P –precipitation, PET – potential evapotranspiration.

Month	Apr	May	Jun	Jul	Aug	Sep
P – PET (mm)	-39.2	-52.9	-55.4	-83.2	-76.3	-45.0

Conclusion

Study results suggest that climatic conditions for agricultural production in North Backa are very variable, deteriorating in the last few decades.

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