IRRIGATION STRATEGY OF SERBIA

Serbia’s Irrigation strategy

Irrigation water requirements & Water availability

Miloš Stanić

Belgrade 2021

Serbia's Irrigation strategy

Irrigation water requirements & Water availability

Goal of this brief is to determine prospects of irrigation development in Serbia in terms of natural, water related factors, namely Irrigation water requirements (IWR) and Irrigation water availability (IWA).

Republic of Serbia is not classified as a country with lack of water resources, but on the other hand there is a problem with unfavourable temporal and spatial distribution of water resources.

Having on mind that irrigation consumes a lot of water and the fact that only small percentage of abstracted water is returned to streams, it is necessary to make water balance calculations that will include spatial and temporal distribution of IWR and IWA for all major catchments in Serbia that contain potential areas for irrigation.

Irrigation water requirements

Methodology & data sources

IWR calculations are based on data from 437 meteo stations: 26 of them are with detailed monthly meteorological data necessary for calculation of reference evapotranspiration ET_0 according to Penman-Monteith method, while the rest contain only the data of monthly precipitation. Detailed results are presented for 8 out of 26 main meteorological stations.

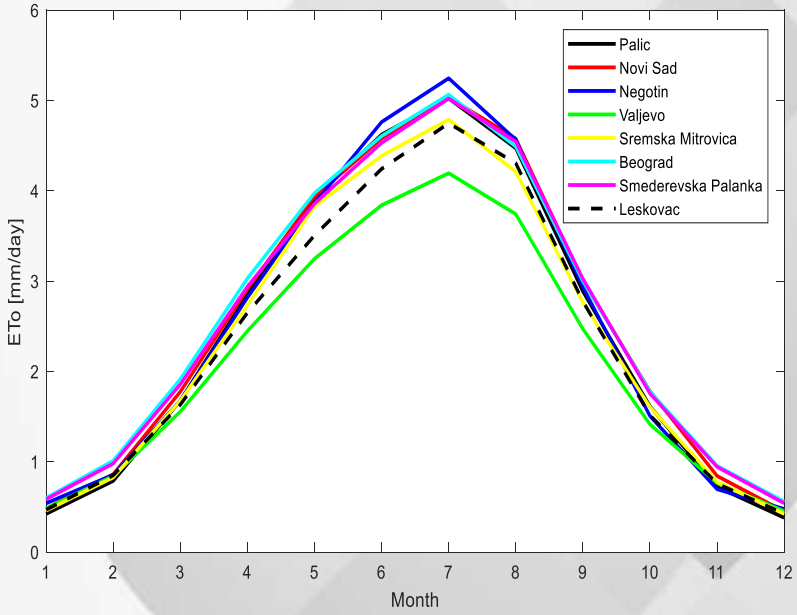
Irrigation water requirements

Results for selected meteorological stations

Selected 8 meteorological stations:

ID	Meteo station	ϕ (°)	λ (°)	z (m.a.s.)
261	Beograd	44.80	20.47	132
705	Leskovac	42.98	21.95	230
394	Negotin	44.23	22.55	42
71	Rimski Šančevi	45.33	19.85	86
3	Palić	46.10	19.77	102
301	Smed.Palanka	44.37	20.95	121
190	Srem. Mitrovica	45.00	19.55	82
210	Valjevo	44.28	19.92	176

Meteorological data for period 1949 – 2019: Temperature – T (°C), Relative humidity – RH (%), Insolation – n (h/month), Precipitation – P (mm/month)



Irrigation water requirements

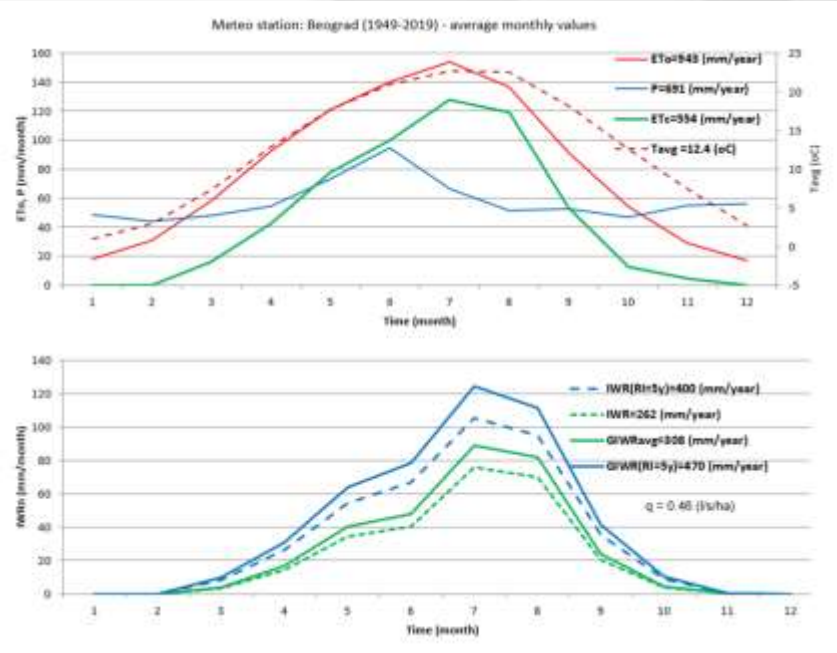
Results for selected meteorological station - Beograd

Crop evapotranspiration – ET_c:

$$ET_c = K_c \cdot ET_0$$

For the purpose of this analysis, uniform cropping pattern is adopted: 25% wheat, 30% maize, 15% vegetables, 15% fruits, 15% industrial crops & 10% second harvest.

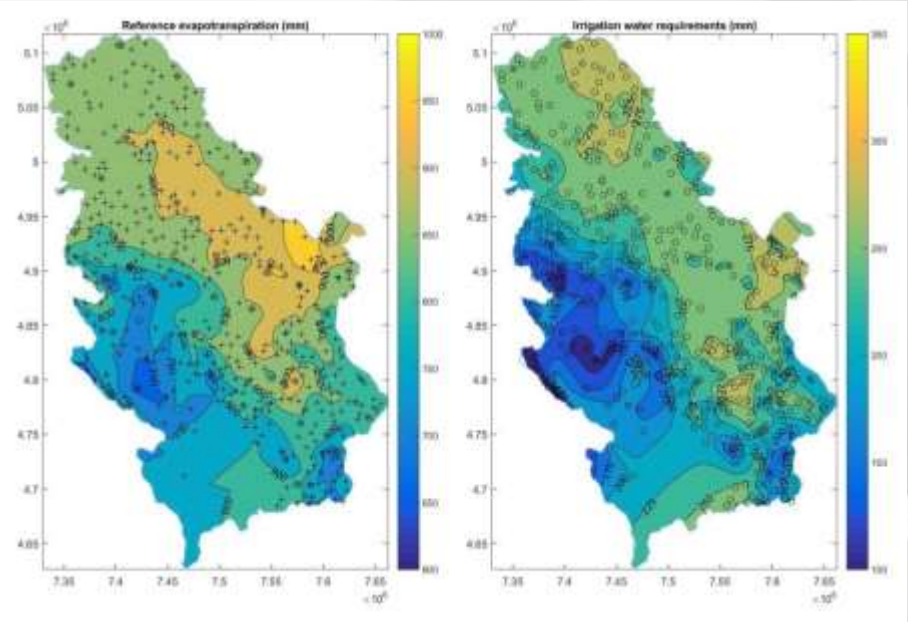
- Net irrigation water requirements – IWR = 262 mm/year
- Gross irrigation water requirements – GIWR = 308 mm/year



Irrigation water requirements

Concluding remarks

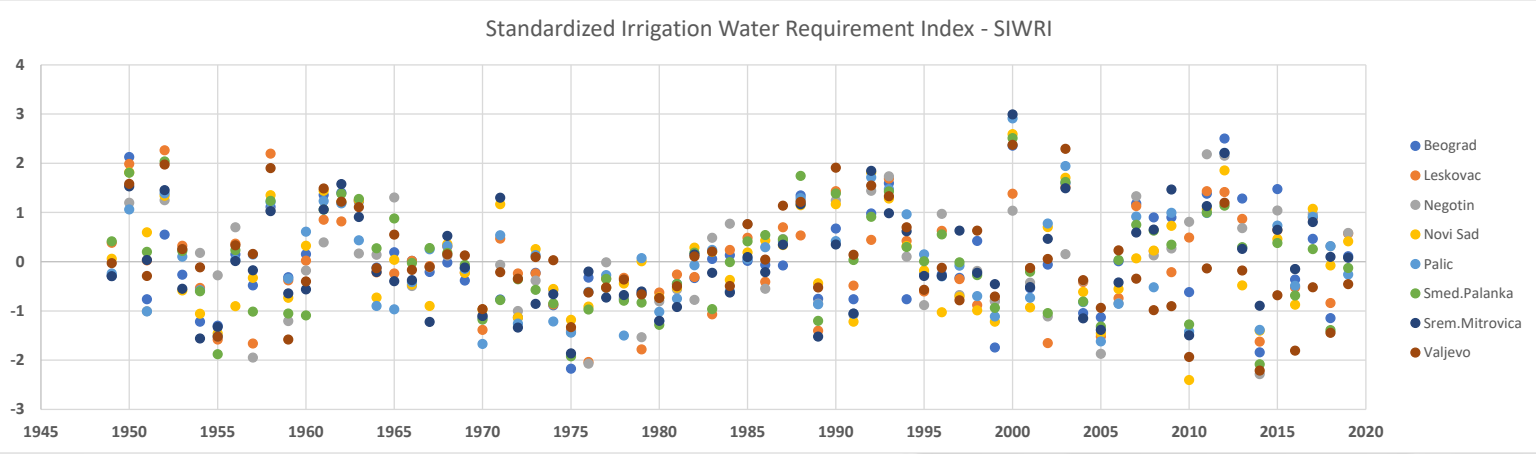
- GIWR are in the range 300-360 mm/year except soth-west parts (<250 mm/year)
- GIWR rises about 50% for drought year with recurrence interval RI = 5 years
- Design irrigation modulus is around 0,45-0,55 l/(s ha) except soth-west parts (< 0.4 l/(s ha))
- Local variations are expected due to differences in cropping pattern and soil characteristics



Irrigation water requirements

Trends in Irrigation water requirements

- Standardized Irrigation Water Requirement Index (SIWRI): $SIWI = \frac{IRW - \overline{IRW}}{\sigma_{IRW}}$
- SIWRI values above 0.84 indicate droughts with recurrence interval (RI) of 5 years



Irrigation water availability

Surface water – direct abstraction from rivers (streams)

- 35 hydrological stations were selected based on spatial distribution and data availability
- Period of analysis: 1990 – 2019
- Calculations are based on measured discharge data
- Average monthly values of discharge were used for analysis
- Adopted criterion for irrigation water availability: fraction (*f*) of the difference between discharge with probability of occurrence 80% ($Q_{80\%}$) and 90% ($Q_{90\%}$) calculated for each month: $Q_{irr} = f \cdot (Q^{i}_{80\%} - Q^{i}_{90\%})$
- f – fraction of available water that will be used for irrigation: 2/3 is adopted value

Irrigation water availability

Surface water – direct abstraction from rivers

- *Južna, Zapadna and Velika Morava subcatchments:* Available water for irrigation 7.45 m3/s, Potential irrigation area (A_{irr}) is about 15000 ha
- *Kolubara catchment:* Available water for irrigation is 0.8 m3/s, Potential irrigation area (A_{irr}) is about 2000 ha
- *Mlava, Pek & Timok catchments*: Mlava catchment - Q_{irr} = 0.39 m^3/s; A_{irr} ≈ 750 ha, Pek catchment - Q_{irr} = 0.19 m^3/s; A_{irr} ≈ 360 ha, Timok catchment - Q_{irr} = 0.47 m^3/s; A_{irr} ≈ 900 ha
- *Drina catchment*: Estimated available water for irrigation 9.3 m3/s, Available water has to be divided between Bosnia & Herzegovina – Republika Srpska and Serbia: assumed 9.3/2=4.65 m3/s, Potential irrigation area is about 10000 ha
- *Sava catchment*: Estimated available water for irrigation 35.9 m^3/s, Potential irrigation area is about 78000 ha. There is potential conflict in water management with water transport.

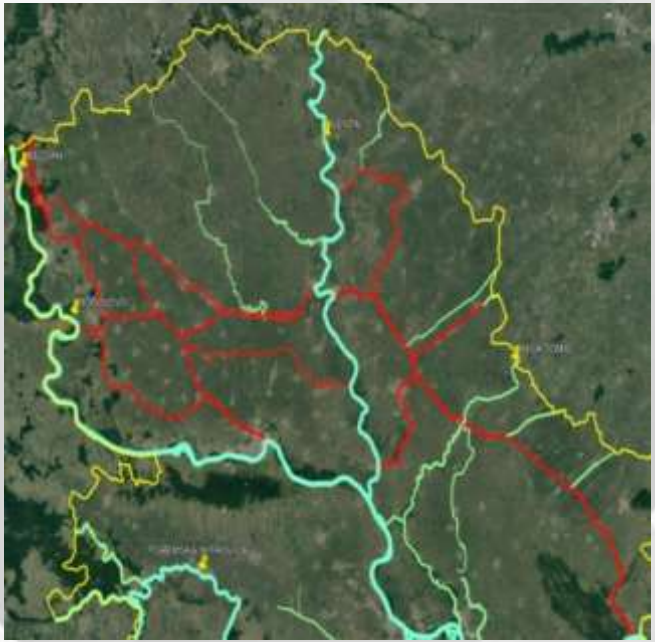
Irrigation water availability

Surface water – direct abstraction from rivers

Dunav, Tisa & DTD system

- Abstraction from Dunabe: Q_{irr}=164 m^3/s, A_{irr}=300000 ha
- Abstraction from Tisa Q_{irr} = 37.3 m3/s, A_{irr}=70000 ha
- There is potential conflict in water management with water transport
- Additional 3000 ha could be irrigated with water abstracted from river Tamiš

StationID	River	Station name	X	Y	A (km2)	Zo (m.a.s)	August	Qirr (m3/s)
42010	DUNAV	BEZDAN	7334254	5081102	210250	80.64	144.6	164
42020	DUNAV	BOGOJEVO	7350350	5044540	251593	77.46	163.9	
44020	TISA	SENTA	7430200	5087875	141715	72.8	37.3	37.3
42401	TAMIŠ	JAŠA TOMIĆ	7489150	5031950	5334	73.46	1.54	1.5

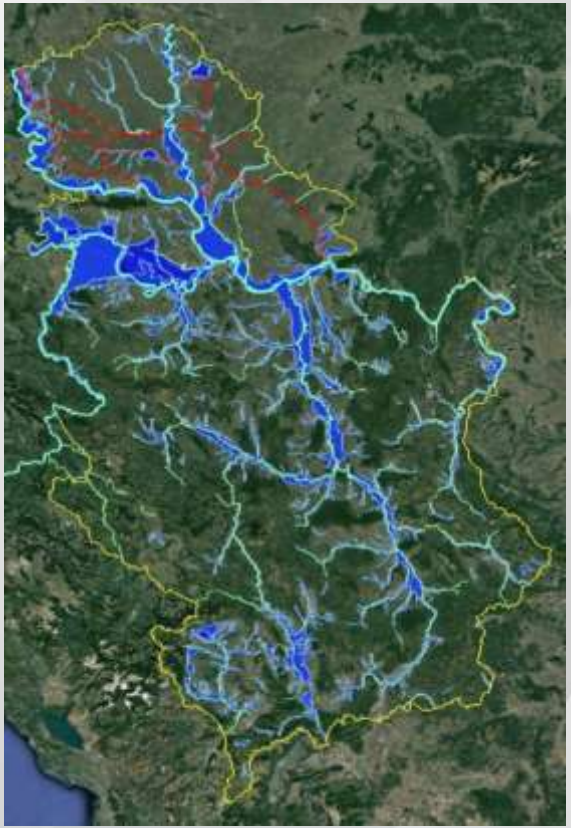


Irrigation water availability

Groundwater – abstraction from river alluvium

Alluvium layers of large rivers are the only possible source of groundwater for irrigation purposes (dynamic reserves)

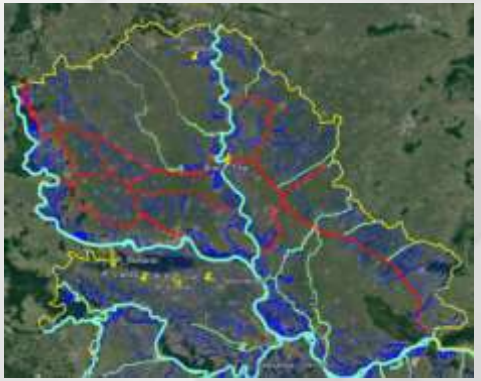
- Approximated potential abstraction from Dunabe alluvium is 5 m3/s and potential irrigation area is estimated to 10000 ha.
- Approximated potential abstraction from Sava alluvium is 3.5 m3/s and potential irrigation area is estimated to 7000 ha.
- Approximated potential abstraction from alluvium in the catchemnt of Velika Morava is 2 m3/s and potential irrigation area is estimated to 4000 ha.



Irrigation water availability

Reservoirs for irrigation

- Existing reservoirs that are planned for irrigation - none of them are single purpose reservoir designed for irrigation only
- Multipurpose management of Flood protection reservoirs: More then 20 reservoirs are planned for flood protection in Kolubara catchment. There is possibility for irrigation of up to 30000 ha from planned flood protection reservoirs.
- Multipurpose management of Water supply reservoirs: existing reservoirs for water supply have potential to be used for irrigation (Bovan, Barje, Gruža, Stubo Rovni, Prvonek). Conservative estimate is that possible irrigation areas from selected reservoirs is 12000 ha.



Conclusions

Irrigation water requirements & Water availability

Potential for irrigation in terms of irrigation water requirement and water availability in Serbia has significant spatial differences.

- Even though **North part of Serbia - Vojvodina**, has low precipitation rate, there is huge potential for irrigation with water that can be abstracted mainly from Dunabe and Tisa rivers and directed through DTD system of channels to individual irrigation systems
- Also there is potential for water withdrawal from Sava river for irrigation of Srem region in Vojvodina
- Based on presented analysis, total potential irrigation area can be estimated to about 450000 ha.
- It should be noted that there is potential conflict in water management in drought periods due to fact that Dunav, Tisa & Sava are international water ways.

Conclusions

Irrigation water requirements & Water availability

- **South from the Sava river** there is much less potential for irrigation in terms of water availability.
- **Mačva region** can be irrigated with water abstracted from Drina, Sava and groundwater, which is in fact alluvium that those two rivers had created.
- Due to fact that Drina is transboundary river, potential abstraction from Drina has to be divided between Srbija & Bosna and Herzegovina. Based on presented analysis, potential irrigation area with water from Drina and its alluvium is more than 17000 ha.
- In **Kolubara catchment**, the water availabile for direct abstraction from rivers is very scarce. (only about 2000 ha could be irrigated in that way). About 20 reservoirs for flood protection are planed to be build in Kolubara catchment area. With proper design and water management rules, some of these reservoirs could be used for irrigation. That would increase potential area for irrigation to more than 20000 ha.

Conclusions

Irrigation water requirements & Water availability

- **Velika Morava catchment** has potential for irrigating of up to 15000 ha, with direct abstraction from rivers.
- If irrigation area is divided with its main contributors: Juzna & Zapadna Morava, then potential areas that could be irrigated with direct withdrawal from rivers is 5000 ha for Južna Morava, 7000 ha for Zapadna Morava and 3000 ha for Velika Morava catchments.
- Additional 4000 ha could be irrigated from groundwater.
- Additionaly, 4 water supply reservoirs with volumes above 20 milion m3, exist in the Velika Morava catchment: Gruža, Bovan, Barje and Prvonek, and with proper water management rules are potential source for irrigation.

Conclusions

Irrigation water requirements & Water availability

- Regions in the **East part of Serbia**, that are **located in the catchments of rivers Mlava, Pek and Timok** and far from Dunabe river, are with least potential for irrigation due to scarce water availability for direct abstraction from rivers.
- Potential irrigation area is up to 2000 ha and it could be increased only with building multi purpose reservoirs, where irrigation would be one of the users.
- In terms of water availability, there is almost unlimited potential for irrigation in the East parts of Serbia, in the areas that are close to the Dunabe river (e.g. regions near Kladovo and Negotin).

Thank you