Co-funded by the Erasmus+ Programme of the European Union

Milica Marković, Mladen Milanović and Slaviša Trajković

Water quality evaluation in Bovan reservoir for irrigation purpose

University of Niš

Faculty of Civil Engineering and Architecture

International Symposium "Water Resources Management: New Perspectives and Innovative Practices„
Novi Sad, 23-24 September 2021

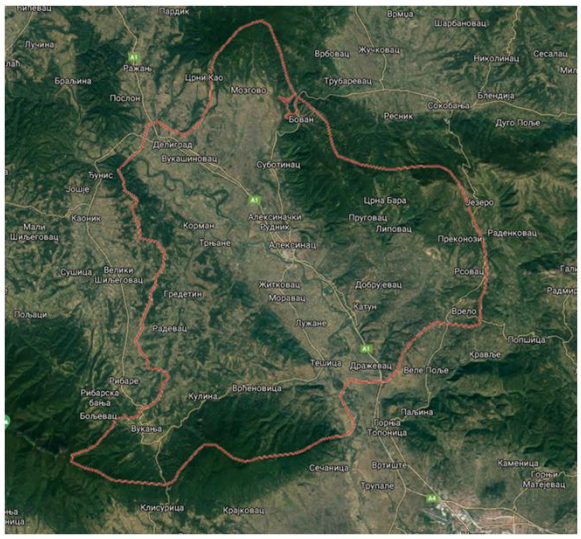
Introduction

Water is the most important natural resource!

- Problem of water resources in the future is related to the quality and quantity of water, due to:
  - *increase of world population*,
  - accelerated *development of industry*,
  - *climate change*.
- Lack of food especially emphasizes the *importance of irrigation systems developing.*

Aleksinac field

- Aleksinac field - arable land of 5660 ha, in the valley of the Južna Morava River,
- The irrigation area is within twelve cadastral municipalities in the municipality of Aleksinac,
- The average plot area is 60,91a,
- The feasibility study (1994) envisages irrigation from the multi-purpose reservoir Bovan.



Aleksinac field

- The total net irrigated area is about 4500ha (7000 plots).
- Two irrigation subsystems are planned on areas of about 2250 ha:
  - I subsystem - gravity-fed system, covering low irrigation zones (< 225 MASL),
  - II subsystem - supplied by pumping water and covering high irrigation zones (> 225 MASL).

The multipurpose reservoir Bovan

Watercourse	Moravica
Nearest settlement	Aleksinac
Total reservoir volume	60 000 000 m^3
Minimal water level	243.00 MASL
Normal water level	252.00 MASL
Maximal water level	261.50 MASL

The multipurpose reservoir Bovan

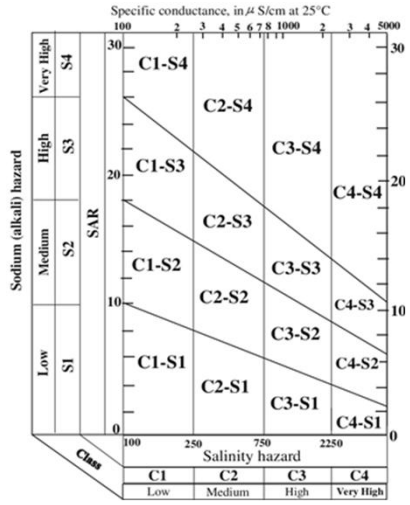
- The main purpose of the reservoir is:
  - water supply,
  - flood protection,
  - protection against sedimentation within the HPS "Iron Gate", +
  - increasing of low water level in the river, additionally
  - hydro power and
  - irrigation.
- Designed reservoir volume envisaged for irrigation purpose is **$15*10^6$ m^3**.

USSL Classification

The US Salinity Laboratory (USSL) classification represents *the method for evaluation of irrigation water quality*, based on the hazards of :

- *salinization* and
- *alkalization*.

of irrigated soils.



USSL classification of irrigation water (Wilcox, 1955)

SAR (Sodium adsorption ratio)

Alkalization of irrigated water can be defined using the *SAR* (*Sodium adsorption ratio*) value:

$$SAR = \frac{Na}{\sqrt{\frac{C_a + M_g}{2}}}$$

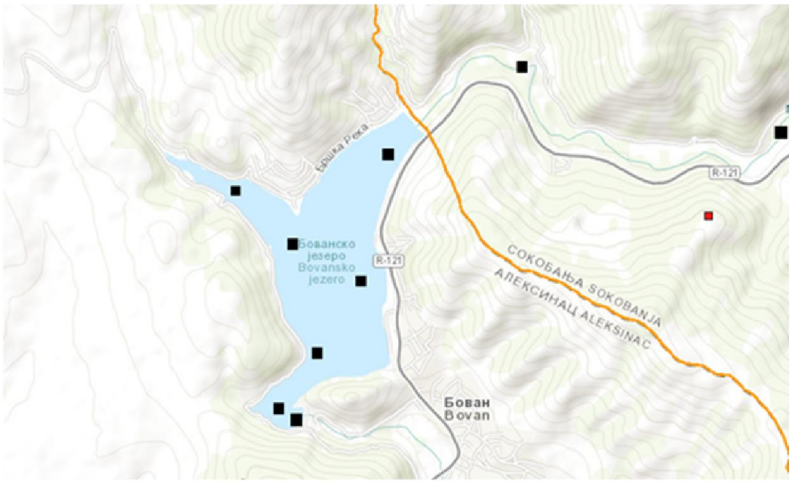
The lack of springs with quality water for irrigation leads to the modification of the basic *SAR* formula into SAR_{corr} :

$$SAR_{corr} = SAR[1 + (8.4 - pHc)]$$

$$pHc = (pk_2 - pk_c) + \mathrm{p}(c_a + M_g) + p(Alk)$$

p - the negative logarithm,
k_2- the second dissociation equilibrium constant of carbonic,
k_c- the solubility equilibrium constant for calcite.

Sampling locations

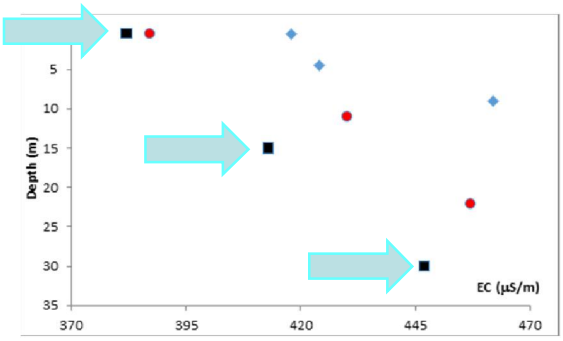


Bovan Reservoir-sampling locations

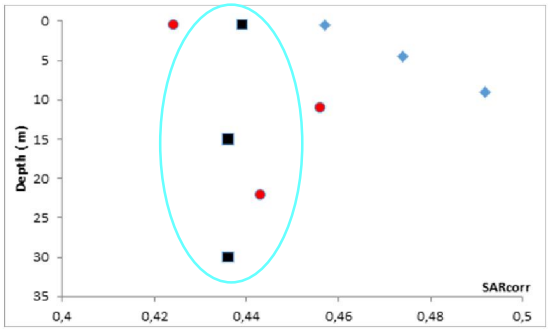
USSL classification of reservoir water

	A1	A2	A3	B1	B2	B3	V1	V2	V3
Depth (m)	0.5	15	30	0.5	11	22	0.5	4.5	9
EC	382	413	447	387	430	457	418	424	462
S.O. (mg/l)	254	264	291	249	279	288	267	273	301
Na (mg/l)	7.2	7.1	7.2	6.9	7.3	7.4	7.4	7.7	7.9
K (mg/l)	1.8	1.9	3	1.1	2	2.2	1.9	2	1.9
Ca (mg/l)	62	64	71	63	75	75	72	72	83
Mg (mg/l)	17	17	20	15	9	20	11	11	7
CO_3 (mg/l)	7.2	0	0	7.2	0	0	7.2	6	5.4
HCO_3 (mg/l)	196	232	255	200	242	256	218	225	250
SAR corr	0.439	0.436	0.436	0.424	0.456	0.443	0.457	0.474	0.492
Class	C2S1	C2S1	C2S1	C2S1	C2S1	C2S1	C2S1	C2S1	C2S1

EC and SARcorr vs. sampling depth



EC vs. sampling depth



SARcorr vs. sampling depth

Results

Results indicate the same water quality class:

1. Low risk of alkalization
2. Medium to good quality irrigation water
3. Medium risk of salting

Conclusion

- Reservoir water can be used for irrigation of crops that are moderately tolerant to the presence of salt in the water.
- It is recommended that measures should be taken in terms of reservoir management in order to improve the quality of irrigation water and consequently to increase number of crops to be threated.

Thank you for your attention!