Food and Agriculture Organization of the United Nations

Salt-affected soils: threats and potentials

Considering spatial heterogeneity of drip irrigated salinity in soil monitoring

Joint meeting of
INSAS and SUSTAIN

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International Network of Salt-Affected Soils

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SUSTAIN Sustainable use of salt-affected lands

VNIVERSITAT DE VALÈNCIA

International Union of Soil Sciences

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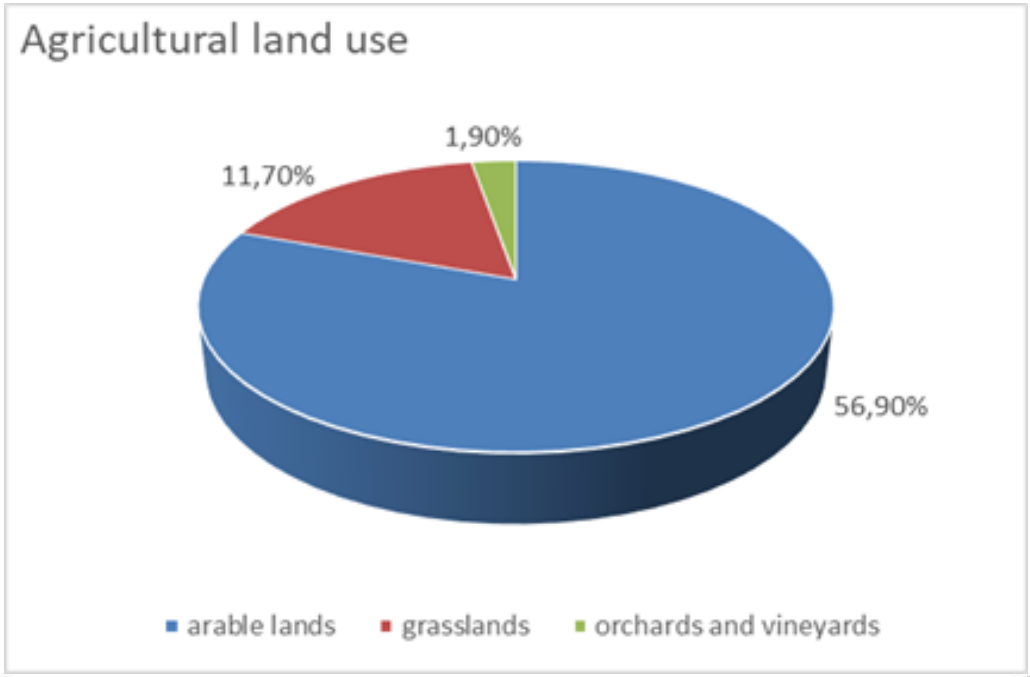
GLOBAL SOIL PARTNERSHIP

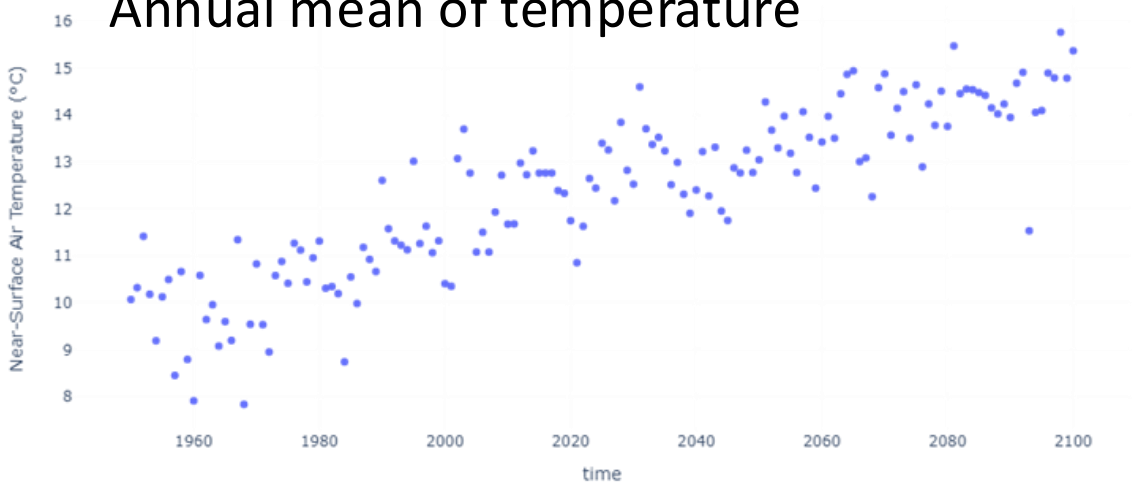
Land use in Ukraine

Total area	603,6 thousand km ^{2}
Agricultural land	402,3 thousand km ^{2} (70,5%)
Cropland	352,4 thousand ha

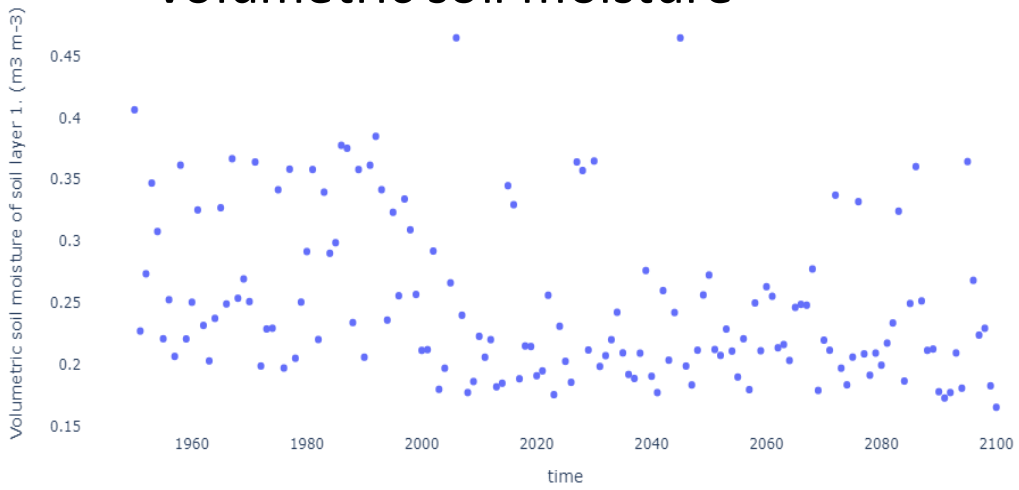


Climate projections (1960-2100) RCP 4.5

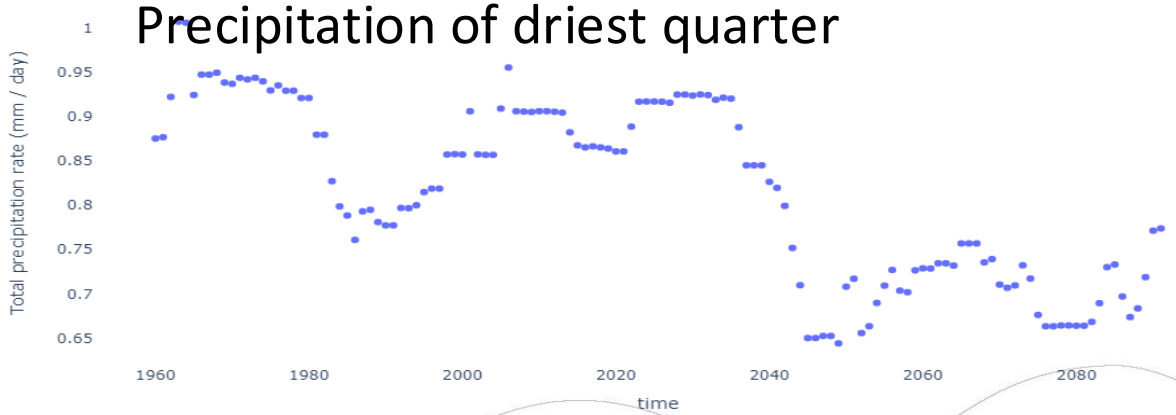
Annual mean of temperature



Volumetric soil moisture

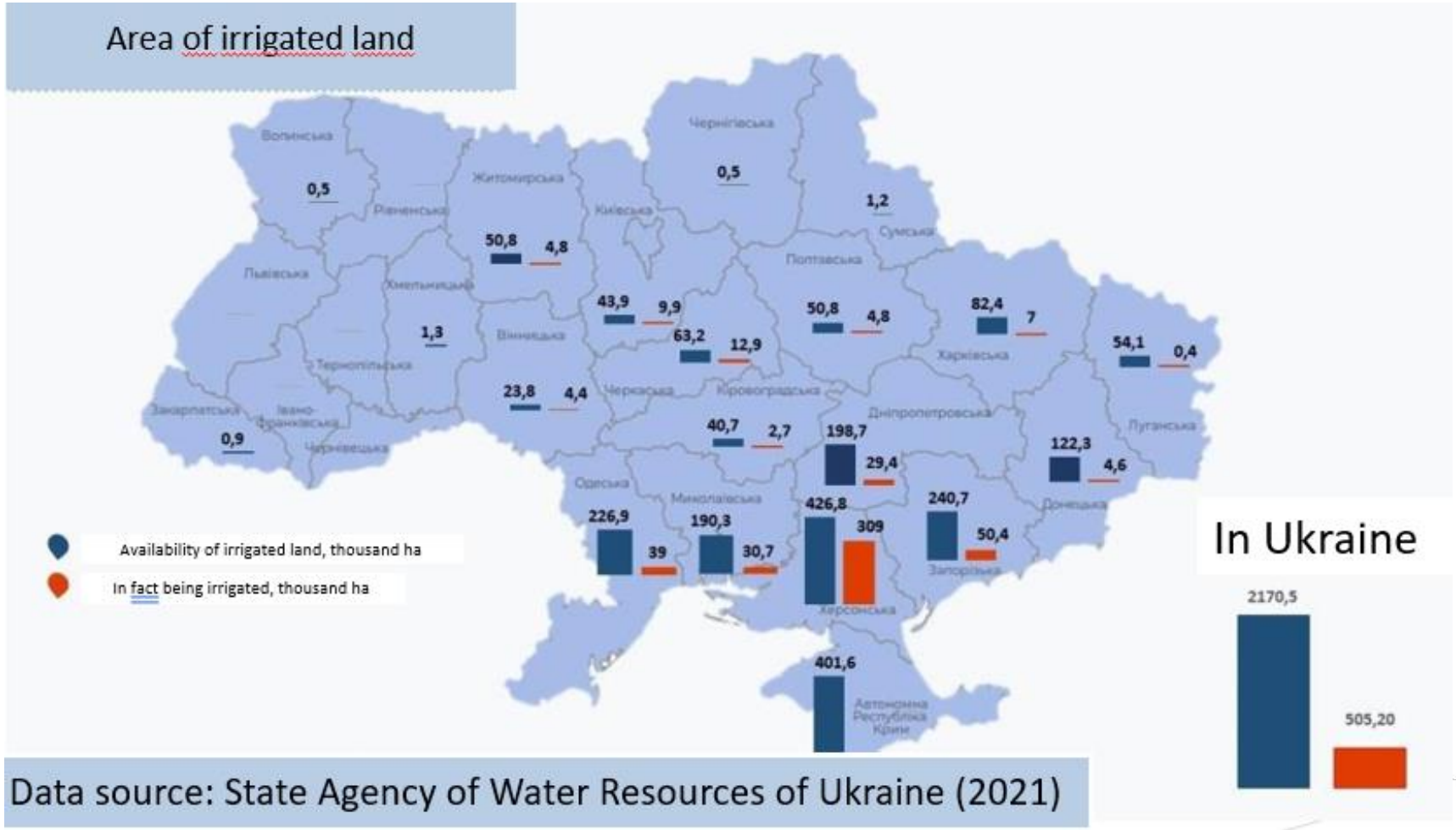


Precipitation of driest quarter



Data source: Copernicus Climate change

Irrigated areas by regions of Ukraine



The main reasons for the decline in the use of sprinkler irrigation

- ✓ Limited available water resources suitable for irrigation when expanding irrigated areas/introducing new irrigated areas;
- ✓ Unstable farmer demand for sprinkler irrigation;
- ✓ Expense;
- ✓ Unsatisfactory technical condition of irrigation systems placed in use before 2000;
- ✓ Lack of technical support, etc.

Object of study

The object of study – Southern chernozem (Chernozems Calcic) on private farms and land holdings of individual business entities in the steppe zone of the Ukraine.

The problem is – influence of drip irrigation on soil properties and consider spatial pattern of soil parameters in soil monitoring.

The main objective of the study is – to investigate changes in salinity parameters in different zones of the soil moisture contour under drip irrigation.

Fig. 1: Southern chernozem

Causes of soil degradation under drip irrigation

- ✓ Exceeding technological irrigation limits
- ✓ Poorer quality of irrigation water
- ✓ Use of drip irrigation on previously irrigated soils with varying levels of irrigation degradation
- ✓ Mineralized unconfined groundwater
- ✓ Salt content of bedrock

Fig. 2: Strip salinisation under drip irrigation (after irrigation)

Chemical composition (average) and irrigation assessment of irrigation water quality of the Ingulets irrigation system

Water source	pH	Amount of salts, g/dm^3	Ion content, meq/dm^3							Irrigation assessment of soil degradation risk (NSS 2730)		
			HCO_3^-	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	K^+	salinity	solonetzization	alkalinisation
Main channel	6,9-7,1	1,96-2,11	2,9	18,2	10,8	6,5	8,5	16,5	0,4	2	2	1

Southern Chernozem (non-irrigated)

Indicator	Parameters
$CaCO_3$, %	1,7-2,8
Ca/Na (water extract 1:5)	3,5-6,4
Exchangeable Na^+ (0-50 sm), mg/100 g	0,2-0,4
Humus (0-25 sm), %	2,0-3,1
Silt (0-50 sm),%	25,4-34,9
Clay (0-50 sm),%	39,4-52,4

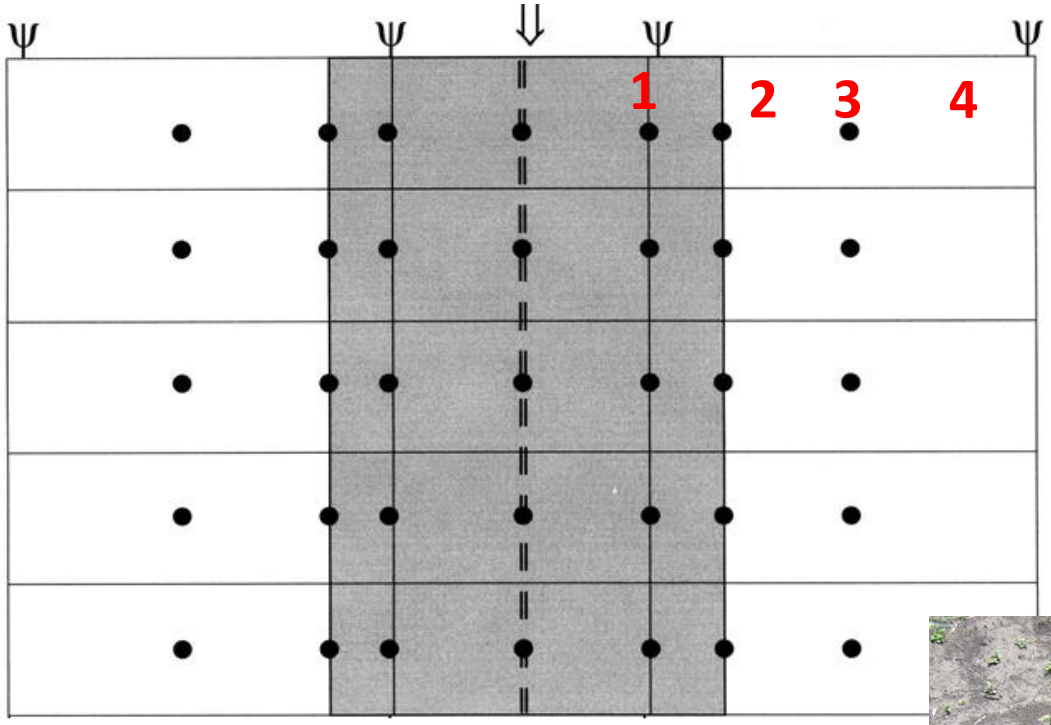
Soil-salinity survey on irrigated land in Ukraine

NSS 7850:2015 Soil quality. Procedure for soil-salt survey

- At the local monitoring level, the basic scale of the soil salinity survey is 1:10000.
- Soil contours are the subject of the survey, with borehole points placed in such a way as to cover all soil subdivisions or contours of salinity of soils.
- Average number of points per 1 km^2 (100 ha) - 6-10.

Photo source : UkrAgro

Sampling



Ψ A row of vegetable crops
‖ Location of the irrigation pipeline
⇩ Pipeline
• Soil sampling points
Moisture zone

layers
0 - 25 cm
25 - 50 cm
50 - 75 cm
75 - 100 cm

Fig. 3: Soil sampling scheme

Unconfined groundwater table up to 2 m

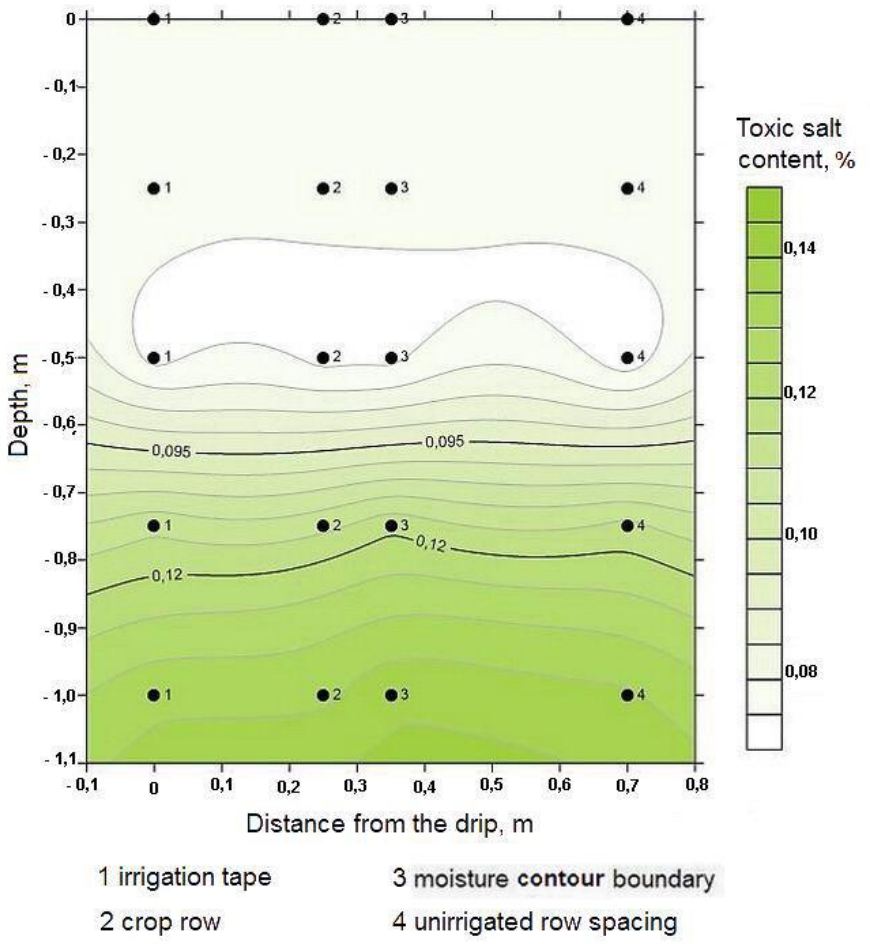


Fig. 4: Toxic salt content,%

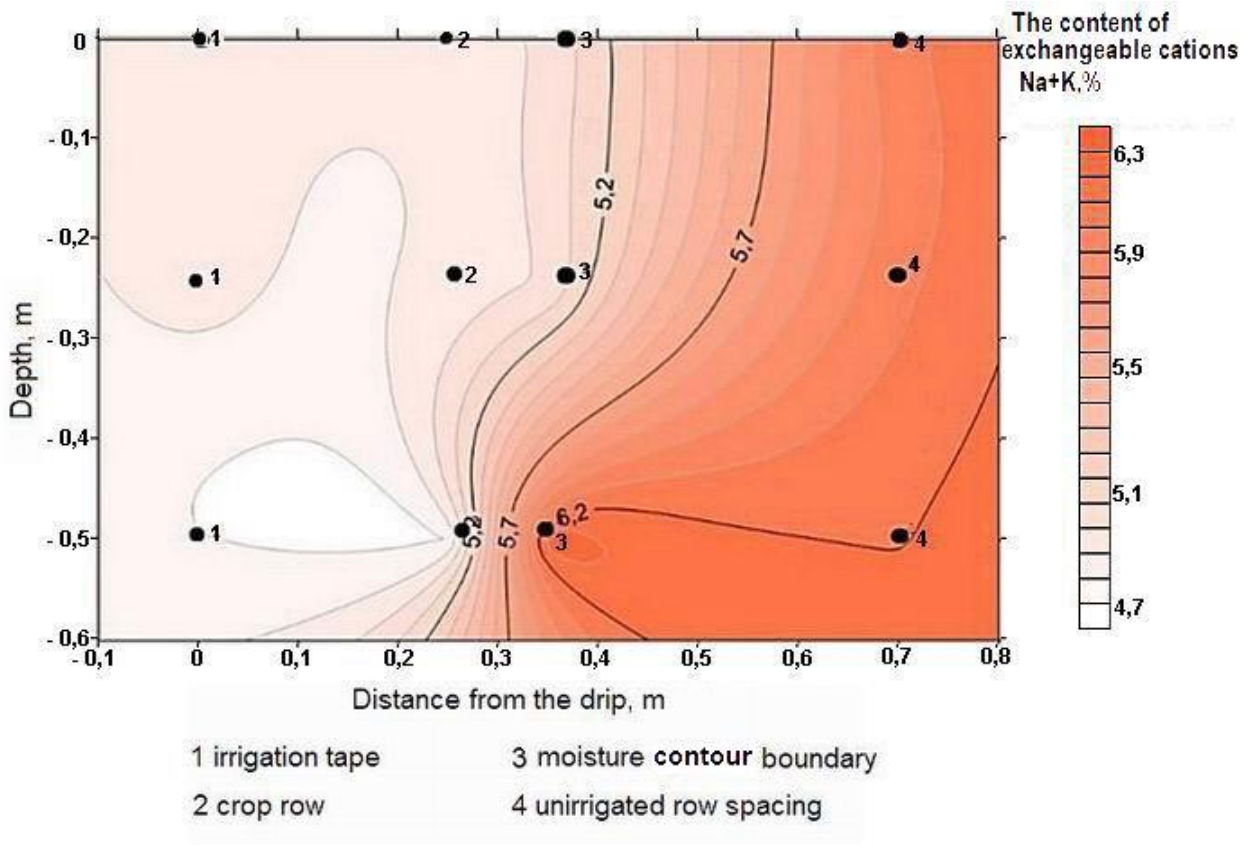


Fig. 5: Exchangeable Na+K content,%

Unconfined groundwater table 3-5 m

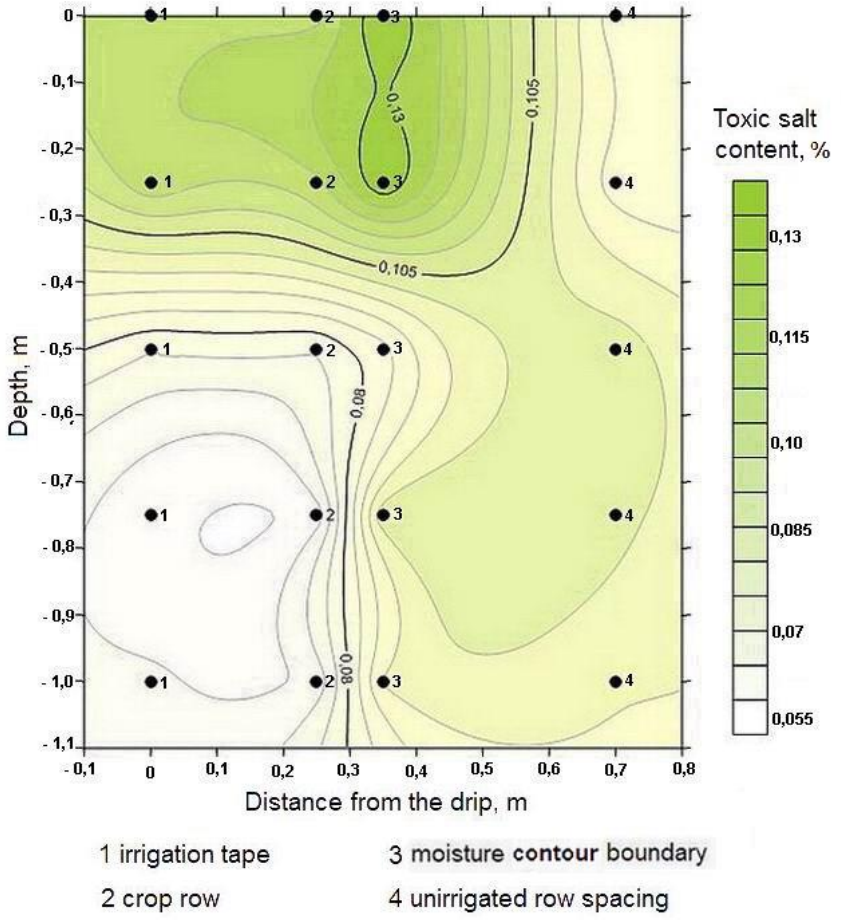


Fig. 6: Toxic salt content,%

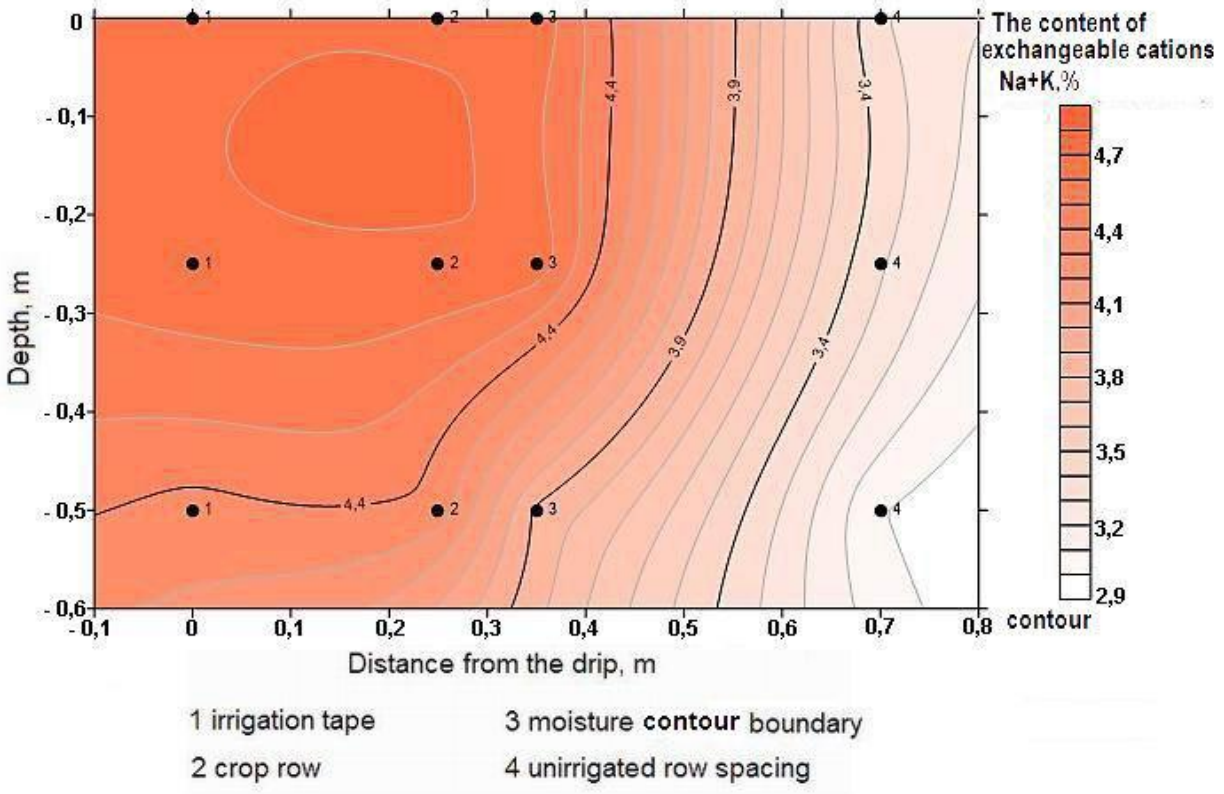


Fig. 5: Exchangeable Na+K content,%

Conclusion

- Under drip irrigation, accumulation of toxic salts was observed within the irrigation zone with maximum concentration at the boundary of the irrigation contour. The content of exchangeable Na+K was high in the layers 0-25 cm and 25-50 cm layers. When growing different vegetable crops, the moisture zone does not correspond to the same one every year.

- The mechanical mixing of the soil in the wetting zone and the row spacing during post-irrigation tillage cause a levelling of linear halogenation manifestations only in the upper 0-25 cm soil layer. In the lower horizons, degradation changes remain stable over a long period of soil use and tend to spread further.

- The proposed soil sampling scheme for monitoring and mapping soil salinity under drip irrigation provides a detailed description of the extent of the spatial impact of drip irrigation on the soil.

- The high variability of the soil parameters in the chain irrigation tape - crop row - moisture counter boundary - row spacing' has been demonstrated. This variability cannot be detected using other sampling schemes.

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Thank you

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Ministry of Agriculture, Nature and Food Quality of the Netherlands