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EVALUATION OF SALINE-SODIC ALLUVIAL SOIL IN THE STĂNCUȚA AREA AND IMPLICATIONS FOR CROP TECHNOLOGY

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Abstract: *This study provides an integrated pedological and agrochemical assessment of a mollic saline–sodic alluvial soil on an 8.24 ha agricultural area located in Stăncuța (Brăila County, Romania). Field survey and soil sampling were conducted in March 2025 following the national methodology for pedological studies, including profile description and standardized laboratory analyses. The soil shows major edaphic constraints related to salinity–sodicity, fine texture, poor drainage and high compaction, which collectively resulted in a low natural land suitability rating (NN = 37) and classification into quality class IV for arable use. Agrochemical data indicate a neutral to slightly alkaline reaction, moderate nitrogen supply, good to very good available phosphorus, and excessive potassium, suggesting an unbalanced nutrient status. Based on the diagnosis, risk-based management recommendations are proposed, emphasizing soil amelioration and sustainable use: chemical amendments (gypsum where sodicity occurs), organic matter inputs, conservation-oriented tillage to reduce compaction, site-specific fertilization, and salt-tolerant crops/rotations for yield stabilization under class IV conditions.*

• Introduction

Saline–sodic soils are a **major constraint for agriculture** because they reduce crop performance through both chemical and physical degradation. High soluble salts induce **osmotic stress** and **nutrient imbalance**, while excess **exchangeable sodium** disperses clays, increasing **compaction** and decreasing **permeability** and **aeration**. In the **Lower Danube Plain (Romania), shallow mineralized groundwater** and **poor drainage** favour salt accumulation, increasing **yield instability** and **production risk.** Therefore, **integrated pedological** and **agrochemical evaluation** is essential to quantify land limitations, determine **land suitability**, and design site-specific, **risk-based crop technologies** focused on **soil amelioration** and **sustainable land use**.

• Material and method

Study area. The study was conducted in the administrative territory of **Stăncuța commune (Brăila County, Romania)**, within the Lower Danube Plain, on an agricultural area of **8.24 ha** located near the Danube floodplain. The relief is **flat alluvial floodplain**, favoring poor natural drainage.

Climate and hydrology. The site is characterized by an excessive continental climate with a mean annual temperature of **~11 °C** and annual precipitation of **450–460 mm**. The groundwater table occurs at **2.01–3.00 m** and is mineralized, supporting capillary rise and salt accumulation under moisture deficit.

Field survey and soil sampling. Field investigations were performed in **March 2025**. At the time of survey, the land had been uncultivated for **>5 years**. A representative soil profile was opened and described (horizons, color, texture, structure, compaction, carbonates/salts, and hydromorphic features). Soil samples were collected by genetic horizons; agrochemical interpretation followed the standardized 0–20 cm layer.

Laboratory analyses. Soil pH was determined potentiometrically; total N by the **Kjeldahl method**; available P by **Egner–Riehm**; and exchangeable K by **NH_4OAc extraction**. Salinity and sodicity were assessed using soluble salts and exchangeable Na, and **CEC** was used to characterize nutrient retention capacity.

Land suitability assessment. Natural land suitability for arable use was evaluated using the Romanian **MESP** methodology integrating soil, relief, climatic, and groundwater factors. The suitability index **(NN)** was computed as the arithmetic mean of crop-specific suitability scores and used to assign the corresponding quality class.

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• Results and discussions

Pedological classification and natural land suitability assessment

Location	Stăncuța administrative unit, Brăila County
Investigated area	8.24 ha
Soil group	Protisols
Soil type / subtype	Mollic saline–sodic alluvial soil
Parent material	Alluvial deposits
Groundwater depth	2.01–3.00 m
Natural land suitability rating (NN)	37
Quality class (arable use)	Class IV
Agricultural use	Conditionally suitable

Agrochemical properties of the arable layer (0–20 cm)

Indicator	**Range / value**	**Assessment**
pH	6.45–7.31	Neutral to slightly alkaline
Humus (%)	3.59–3.90	Low to moderate
Total nitrogen (%)	0.191–0.249	Moderate supply
Nitrogen index (IN)	2.49–3.63	Medium
Available phosphorus (P_AL, ppm)	71–139	Good to very good
Exchangeable potassium (K_AL, ppm)	600–783	Excessive
Cation exchange capacity (cmol(+)/kg)	88.6–100.2	Very high

Note: 0–20 cm represents the standardized agrochemical sampling/interpretation depth.

Soil texture and physical implications

Horizon (cm)	**Texture**	**Total clay (%)**	**Implications**
0–19 (Am)	CL	~46.5	Reduced permeability
19–53 (C1)	CL	~57.1	High compaction tendency
53–77 (C2k)	CL	~52.0	Poor drainage
77–150 (C3kscac)	SiCL	~63.7	High risk of densification

Salinization and sodication within the soil profile

Horizon (cm)	**Salinity type**	**Intensity**	**Na/T (%)**	**Assessment**
0–53	-	Non-saline	<1	Non-alkaline
53–77	Chloride	Weak	~1.3	Non-alkaline
77–150	sulphate	Moderate	≈7.0	Slightly sodic

• Conclusions

- **NN = 37** (Class IV) confirms a **low inherent productive potential** under current hydro-pedological constraints.
- The soil's fertility status is **unbalanced** (moderate N vs. high P and excessive K), **requiring adjusted, differentiated fertilization**.
- **Fine textures** (**≈46–64% clay across horizons**) increase susceptibility to d**ensification/compaction and reduce permeability.**
- Subsoil salinity–sodicity indicates that degradation may **expand upward** under drought or improper management.
- Recommended cropping should prioritize tolerant species (**barley, sorghum, perennial grasses**), while **potato** and **grain legumes** should be avoided on non-ameliorated soils.
- **Implication:** integrating pedological + agrochemical diagnostics with land suitability rating supports **practical, site-specific decisions** for sustainable agriculture on salt-affected soils.