MAP OF SOIL SALINISATION RISK IN BRAILA PLAIN

Victoria MOCANU, Sorina DUMITRU, Valentina COTEȚ, Marius EFTENE

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection - ICPA, Bucharest, Bd. Marasti, nr. 61, sector 1, CP 011464
Corresponding author: vic_mocanu@yahoo.com

Abstract: *Land degradation is an important problem of actual society. In order to protect and conserve the environment, there is a need of an adequate knowledge of all environmental resources and of identifying the risks to which they are exposed. The objective of this paper is to identify soil salinity risk areas from Braila Plain. Researches conducted in this area, until today, have been targeted in particular to issues related to the soil and land inventory, not to the risk assessment of degradation processes. The Southern part of Romania is the region most exposed to desertification. Also, over 3/4 of the irrigated agricultural area are found here, as well as high-drained land reclaimed from the sea. At world-wide, many projects have been developed aiming at identifying anthropogenically induced soil degradation: GLASOD project (Global Assessment of the Status of Human Induced Soil Degradation), developed by UNEP-ISRIC, 1990, ASSOD project (Assessment of Human Induced Soil Degradation in South and South-Eastern Asia) undertaken by UNEP, FAO, ISRIC in 1995, SOVEUR (Mapping of Soil and Terrain Vulnerability in Central and Eastern Europe) developed by UNEP, FAO, and ISRIC, 1995, and RAMSOIL (Risk Assessment Methodologies for Soil Threats). The final result consists in a map achieved by processing information from soil map 1:200 000, from the Geographic Information System SIGSTAR 200, and from several scientific papers developed in the study area. The information has been processed with the program ArcView 3.2. The results of this research could be used in several research fields, mainly in the knowledge, use and improvement of agricultural land (irrigation, drainage, fertilization, amendment, and others) and the acquisition and use of a tool to base the political decisions regarding the environmental management (the location of monitoring systems in the territory, the development of a network of protected areas, the establishment of some priorities in recovery and reconstruction of damaged areas after environmental degradation).*

Key words: *salinisation risk, Braila Plain, soil map*

INTRODUCTION

Land degradation is an important problem of actual society, being defined as temporary or permanent decline of productive capacity of land (FLOREA, 1997). In order to protect and conserve the environment, there is a need of an adequate knowledge of all environmental resources and of identifying the risks to which they are exposed.

The Southern part of Romania is the region most exposed to desertification. Also, over 3/4 of the irrigated agricultural area, as well as high-drained land reclaimed from the sea are found here.

At world-wide, many projects have been developed aiming at identifying anthropogenically induced soil degradation: GLASOD project (Global Assessment of the Status of Human Induced Soil Degradation), developed by UNEP-ISRIC, 1990; ASSOD project (Assessment of Human Induced Soil Degradation in South and South-Eastern Asia) undertaken by UNEP, FAO, ISRIC in 1995; SOVEUR (Mapping of Soil and Terrain Vulnerability in Central and Eastern Europe) developed by UNEP, FAO, and ISRIC, 1995, and RAMSOIL (Risk Assessment Methodologies for Soil Threats), developed by JRC, 2007-2009.

Salinisation is a threat for soil in arid and semi-aride zone and it means the accumulation of soluble salts of sodium, magnesium and calcium in soil to the extent that soil fertility is severely reduced (ECKELMANN et al., 2006).

Factors leading to excessive accumulation of salts in soil may be natural (e.g. rising groundwater, saline surface and ground waters and marine influence) or anthropogenic (e.g. irrigation, hydrological modification, chemical additions and disposal of saline wastes).

Assessment of the risk of regional salinization involves integration of hydrology, hydrogeology, soil and land management issues (BUI et al., 1996) and can be combined with simulation models and geographical information systems (GISs) (DE PAZ et al., 2004).

Generally, three types of approaches exist to identify areas at risk (ECKELMANN et al, 2006):

1. Qualitative approach, using expert knowledge to evaluate main processes, formulate criteria and discover (local) areas at risk.
2. Quantitative approach, based on measured data, providing relative comparisons regarding baselines and thresholds.
3. Model approach, using models to predict the extent of soil degradation, taking local conditions into account. This approach enables assessment of trends by scenario analysis.

The objective of this paper is to identify soil salinity risk areas from Braila Plain. Researches conducted in this area, until today, have been targeted in particular to issues related to the soil and land inventory, not to the risk assessment of degradation processes.

In order to obtain the map of soil salinity risk in Braila Plain, in natural conditions, a quantitative expert analysis method was used, and climate, soil texture, groundwater depth, salinity have been taken into consideration.

The studies were based on directly measured database. They used field observations and laboratory analysis methods, and they focused on salt accumulation processes and gave the possibilities and principles for artificial drainage to avoid the risk of salinisation.

MATERIAL AND METHODS

In order to achieve the goal of the paper, the following materials have been used:

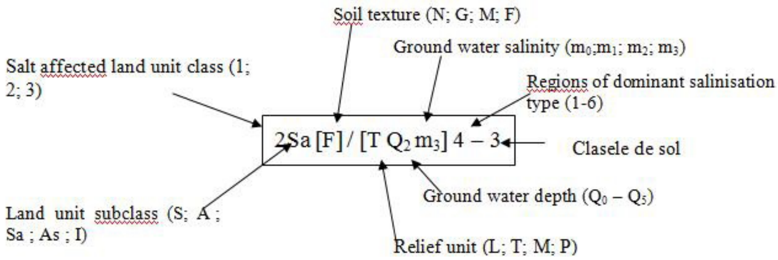
- The soil map of Romania, at the scale 1: 200,000, version 2 (2010);
- The map of salt affected soils and susceptible soils to be affected by salts in Romania, 1:1,000,000 scale (FLOREA, 2007);
- The microzones map of Romania, 1:1,000,000 scale and its attributes table;
- The topographic maps at a scale of 1:25,000, as georeferrenced images.

The test area is Braila Plain (Northern Baragan). Firstly, the microzone map and topographic maps have been used to define the test area boundaries. Secondly, the studied area has been cropped from the soil map, 1:200,000 scale.

The soil salinity risk areas have be designed using the attributes of the polygons from soil maps at the scale 1:200,000 and soil information from map of salt affected soils and susceptible soils to be affected by salts in Romania, at the scale 1:1,000,000.

Soil were grouped by method proposed by FLOREA, 2007, taking into account the climate, soil texture, groundwater depth, salinity character, relief unities, gleyic character, land unit subclasses, and soil types and classes. All these parameters from the database have been measured or determined and they have been classified and using expert judgments based on these classes, each soil polygon has been characterised from the point of view of its salinity behaviour and risk to salinisation. Therefore, each polygon was characterised using the complex formula for the salt affected land unit (FLOREA, 2007). The classes of salt affected lands have been designed using the Cod_u_gen parameter of soil database (description of soil map units) and the gleyic character. The subclasses of salt affected lands have been designed considering the soil type and the saline and alkaline character. The salt affected soil units have been designed taking into account the soil units, the climate parameters, groundwater depth, and relief units. The area occupied by different classes of salt affected lands taking into account different parameters have been computed using Arcview 3.2.

Formula of the salt affected land unit



Classes of salt affected land units

0 Not affected lands
1 Weakly affected lands or with slight risk to be affected by salts; simple measures and some works of salinisation prevention are necessary.
2 Moderately to strongly affected lands or with severe risk to be affected by salts; there are necessary moderate to intensive works and measures for land improvements or for salinisation prevention
3 Very strongly affected lands by salt; there are necessary very intensive works and measures for soil reclamation (but generally unimprovable at economical efficiency terms, excepting rice crop).
4 Lakes
5 Swamps

Subclasses of salt affected land units

0	**0**	Unsaline soils
1	**S**	Saline soils
2	**A**	Sodic (alkalic) soils
3	**Sa**	Saline (main) and sodic (subsidiary) soils
4	**As**	Sodic (alkalic) (main) and saline (subsidiary) soils
5	**I**	Soils with potential acid sulphate salinisation
6	**LC**	Lakes
7	**ML**	Swamps

Soil textural groups

N	Sandy soils
M	Medium textured soils
G	Coarse soils
F	Fine textured soils

Relief units

L	Flood plains, delta
M	Seashore
T	Plains and terraces
P	Tablelands and hills

Ground water depth classes

Q_0	<0,5 m	Q_3	2 – 3 m
Q_1	0,5 – 1 m	Q_4	3 – 5 m
Q_2	1 – 2 m	Q_5	> 5 m

Ground water salinity classes

m_0	<1.0 g/l
m_1	<1.5 g/l
m_2	1 – 2 g/l
m_3	>2 g/l

Regions of dominant soils

1	Chloride type	**4**	Sulphate-soda type
2	Sulphate-chloride type	**5**	Soda type
3	Chloride sulphate type	**6**	Various type

Soil units

1 **Salsodisols (very strongly affected soils by salts)**
1 - Solonchaks (seaside)
2 - Solonchaks and Solonetz
3 - Solonetz
4 - Solonetz and Solonchaks developed or derived from old saline sediments (“residual“)

2 Weakly to strongly affected soils by salts

5 - Salic soils, often and sodic, locally solonchaks

6 - Sodic soils, often and salic, locally solonetz

7 - Saline swamps soils

3 Unaffected soils but susceptible to be affected by salts

8 - Limnosols and Histosols, potentially acide -sulphate

9 - Soils with ground-water, often sodicized and in depth salinized, locally solonetz from subarid-subhumid zone (out of flood-plains)

10 - Soils with ground-water, from humid zone

11 - Flood plain soils, locally salinised, from subarid-subhumid zone

4 Unaffected soils and unsusceptible to be affected by salts

12 - Flood plain soils from humid zones

13 - Uninfluenced by ground water soils, from subarid-subhumid zone

13 - Other soils

15 - Swamps

16 - Lakes

RESULTS AND DISCUSSIONS

A complex characterisation of Braila Plain regarding the soil salinity risk areas have been developed. Areas occupied by salt affected lands taking into account each parameters discussed in Material and Methods have been computed with specific software. The results are presented in following tables and figures: Classes of salt affected land units (table 1, fig. 1), Subclasses of salt affected land units (table 2, fig. 2), Soil units (table 3, fig. 3).

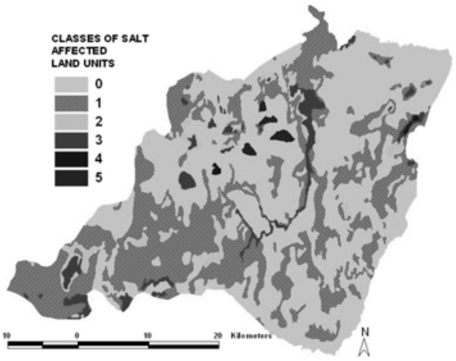


Figure 1. Braila Plain – Classes of salt affected land

Table 1

The area occupied by Classes of salt affected land units

Classes of salt affected land units	Area	
	ha	%
0	85804.26	53.97
1	58801.16	36.98
2	6300.52	3.96
3	6786.43	4.27
4	315.49	0.20
5	979.14	0.62
TOTAL	158987.00	100.00

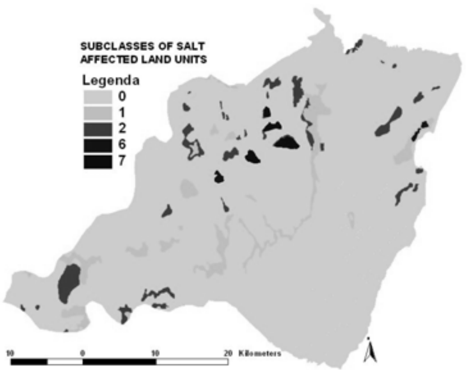


Figure 2. Braila Plain –Subclasses of salt affected land units

Table 2

The area occupied by Subclasses of salt affected land units in Braila plain

Subclasses of salt affected land units	Area	
	ha	%
0	144605.42	90.95
S	7876.71	4.95
A	5210.24	3.28
LC	315.49	0.20
ML	979.14	0.62
TOTAL	158987	100.00

Table 3

The area ocupied by Soil units in Braila Plain

		Soil units	Area	
			ha	**%**
1		**Salsodisols (very strongly affected soils by salts)**		
	2	- Solonchaks and Solonetz	4435.51	2.79
	3	- Solonetz	2350.91	1.48
2		**Weakly to strongly affected soils by salts**		
	5	- Salic soils, often and sodic, locally solonchaks	3441.19	2.16
	6	- Sodic soils, often and salic, locally solonetz	2859.32	1.80
3		**Unaffected but susceptible to be affected soils by salts**		
	9	- Soils with ground-water, often sodicized and in depth salinized	59234.86	37.26
	11	- Flood plain soils, locally salinised, from subarid-subhumid zone	1061.73	0.67
4		**Unaffected and unsusceptible to be afeected soils by salts**		
	13	- Uninfluenced by ground water soils, from subarid-subhumid zone	84308.82	53.03
	15	- Swamps	315.49	0.20
	16	- Lakes	979.14	0.62
		TOTAL	158986.97	100.00

From the total area of Braila Plain, 36.8% are weakly affected lands or with slight risk to be affected by salts; simple measures and some works of salinisation prevention are necessary, 3.96 % are moderately to strongly affected lands or with severe risk, while 4.27% are very strongly affected lands by salt.

As regarding the area occupied by subclasses of salt affected land units in Braila Plain, are unsaline soils, 90.95%, saline soils 4.95% and alkaline soils 3.28%. Table 3 highlights that 53.03% of the total area are Unaffected soils and unsusceptible to be affected by salts, while 38.93% are unaffected soils, but susceptible to be affected by salts. Only 4.27% are very strongly affected by salts and 3.96% are weakly to strongly affected by salts.

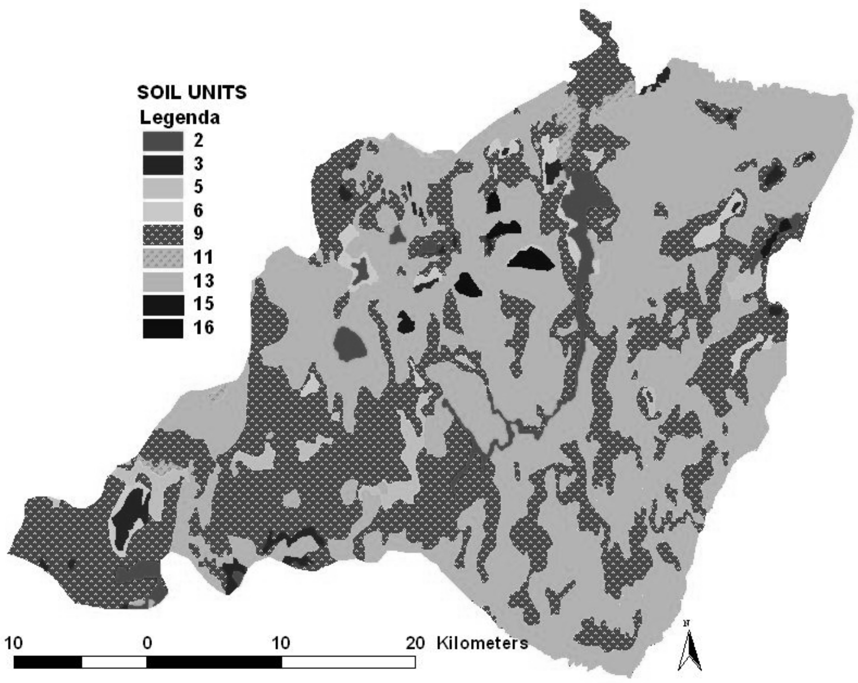


Figure 3. Braila Plain – Soil units

CONCLUSIONS

A complex characterisation of Braila Plain could be possible using the method proposed by Florea (2007).

Some information about soils affected by salts, as well as about soils with risk to salinisation, are available. The soil components of soil map, 1:200,000 scale, are characterised by all parameteres included in soil formula for salt affected soils: classes and subclasses of salt affected land units, groundwater depth and salinity, textural classes, relief units, dominant salinization type, and soil units.

The area and percentage of each parameter classes are computed, and some considerations about each of it are presented. The study area is susceptible to salinisation, and some additional information about risk assessment could be obtained from this study. From the total area of Braila Plain, 36.8% are weakly affected lands or with slight risk to be affected by salts; simple measures and some works of salinisation prevention being necessary, 3.96 % are moderately to strongly affected lands or with severe risk, while 4.27% are very strongly affected lands by salt.

The results of this research could be used in several research fields, mainly the knowledge, use and improvement of agricultural land (irrigation, drainage, fertilization, amendment, and others) and the acquisition and use of a tool to base the political decisions regarding the environmental management (the location of monitoring systems in the territory, the development of a network of protected areas, the establishment of some priorities in recovery and reconstruction of damaged areas after environmental degradation).

BIBLIOGRAPHY

1. BUI, E., 1997 – Assessing the regional risk of salinisation over the Dalrymple Shire. Technical report 26/97, CSIRO Land and Water, PO Box 1666, Canberra, ACT 2601, Australia.
2. DE PAZ, J. M., VISCONTI, F., ZAPATA, R., SANCHEZ J., 2004 – Integration of two simple models in a geographical information system to evaluate salinization risk in irrigated land of the Valencian Community, Spain, Soil Use and Management (20): 333-342.
3. ECKELMANN, W., BARITZ, R., BIALOUSZ, S., BIELEK, P., CARRE, F., HOUŠKOVÁ, B., JONES, R.J.A., KIBBLEWHITE, M.G., KOZAK, J., LE BAS, C., TÓTH, G., TÓTH, T., VÁRALLYAY, G., YLI HALLA, M., ZUPAN, M., 2006 – Common Criteria for Risk Area Identification according to Soil Threats. ESB Research Report No.20, EUR 22185 EN. Office for Official Publications of the European Communities, Luxembourg, 94 pp.
4. FLOREA, N., 1997 – Degradarea terenurilor şi ameliorarea solurilor, Universitatea Creştină „Dimitrie Cantemir" – Bucureşti, Facultatea de Geografie-Turism, Sibiu, 217 pp.
5. FLOREA, N., 2007 – The map of salt affected soils and susceptible soils to be affected by salts in Romania, 1:1,000,000 scale (manuscript)