USING GEOGRAPHIC INFORMATION SYSTEMS TO ESTABLISH AMELIORATIVE MEASURES

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Abstract: *Considering the increasing number of planet inhabitants, the increasing life expectancy and climate changes that we face, achieving stable production by practicing sustainable agriculture is a major goal. Moreover, the improvement of technology for viewing, querying and analyzing data about soil, is leading to the easy use of such software in the agricultural land management. In this work are processed soils data, in order to obtain information about these lands arable classes suitability. This information leads to the establishment of limitations and flaws regarding these lands. The limitations or restrictions regarding the terrains lead to improvement requirements by land improvement works or agricultural-pedology-improvement works.*

Keywords: *suitability, hydro-improvements, pedological improvements, agricultural improvements, GIS*

1. Introduction

Land use without careful consideration of the natural conditions of plant growth and development, as well as changes caused by interference with improvement works may lead to degradation of soil. By soil degradation it means the decrease of their production potential as a result of humans misuse.

On the other hand, terrains limitations or restrictions are their properties that reduce the land use for a particular crop or use. Land limitations are given by the nature and intensity of restrictive factor or factors.

Ameliorative works (land improvement works or agricultural-pedological works) represents all interventions being done to improve some physical, chemical and biological soil features. These measures are specifically targeting less productive soils. The many improvement methods vary depending on the class, sub-class and group, that is to say depending on the nature and intensity of the limiting factors acting on the soil cover.

The objective of this paper is to lay down land arrangement and soil improvement on the study perimeter.

The land area under review is a irrigation plot, belonging to SC Agroind SA, on the Berezeni commune, Vaslui County, Romania.

2. Materials and Methods

The graphical data needed to achieve this study were obtained as follows:

- The limits for: irrigation plot, land reclamation works, roads, cadastral sectors and some parcels boundaries were determined by measurements using GNSS technology and Leica TC 1105total station;
- The parcels limits, which could not be identified in the field were obtained by georeferencing the overall cadastral plan at 1: 25 000;

- The limits of the soil units from the analyzed area were obtained by georeferencing the soils map, drawn at 1: 10 000 [5].

The alphanumeric data used for analysis are:

- The average annual values of precipitation and temperatures during 1970-1992, provided by the meteorological station Huşi [1], which is the closest to the study area;
- Data on analyzed soils, were provided by the Soil study at 1: 10 000 for Berezeni commune prepared by the Office of Soil Survey and Agrochemical Studies, Vaslui in 1997 [5].

To establish the requirements for soil improvement and hydro-improvement works it is necessary to know the limitations and shortcomings of these lands. Deficiencies or limitations of these lands are given by the suitability of these arable lands. The suitability categories (class, subclass, the group and subgroup of arable suitability) shall be determined according to the methodology in force [3], based on soils properties, which deals with both natural conditions and interference from irrigation works. To characterize the soil units based on these properties, some synthetic biophysical parameters are used, converted into organic soil characterization indicators [4].

The 2012 Romanian System of Soil taxonomy was used for inclusion of soils in the new classes, types and subtypes of soil.

For graphic and alphanumeric data analysis was used ArcGIS software, version 9.3.

3. Results and Discussions

In the first instance is analyzed the soil taxonomy at higher level, specifically the class, type and subtype of soil. Data on taxonomy soils at higher level are useful both for establishing the arable suitability class which require knowledge of the soil type and for the information it provides on the soils productivity (by soil type) and some limitations of terrains imposed by the soil subtype.

Soils in the analyzed area of the irrigation plot fall into three soil types (Fig. 1), namely: cernisols, hidrisols and protisols [2].

Thus, within the perimeter of the study area, as a result of soil mapping [5], 4 soil types have been identified, according to the Romanian System for Soil Classification 1980 (SRCS 1980). These 4 types of soil can be grouped in accordance with amendments to the classification of the soils of the new System of Soil Taxonometrie 2012 (2012 SRTS), in three soil types, which under pedological systematic falls in 3 soil classes, namely cernisols class, hidrisols class and protisols class (fig. 1).

Cernisols class occupies 109.9 ha from the total surface land taken in the study area, which represents 11,62%, hidrisols class occupies 139.5 ha, which represents 14,75% while protisols class occupies 696.6 ha, which represents 73,63%.

The encountered Soil types in the analyzed perimeter are chernozems, gleysols and fluvisols (Fig. 1), such information leading us to some first conclusions on the analyzed soils. So: chernozems are very high fertility soils, which can be used for all utilities and crops in Romania; fluvisols are high fertility soils and are being used for a wide range of crops, especially vegetables; gleysoils are low fertility soils, naturally used as pasture, but it can be used for certain crops, contraindicated for vineyards and fruit trees.

If we analyze the encountered soil subtypes (Fig. 1) we can note that all units face soil salinization, criterion associated with soil sodification.

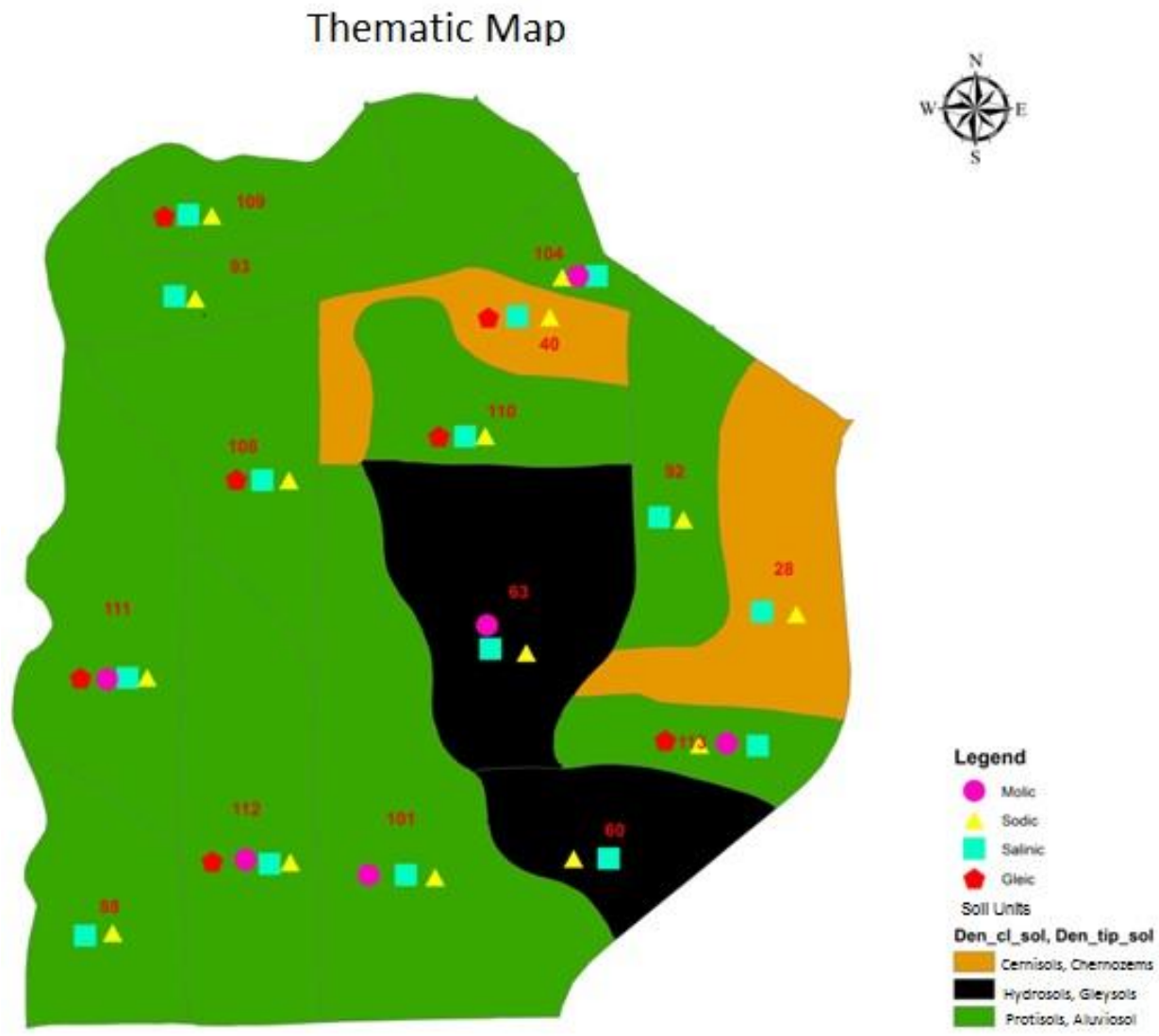


Fig. 1 Soils taxonomy at higher level

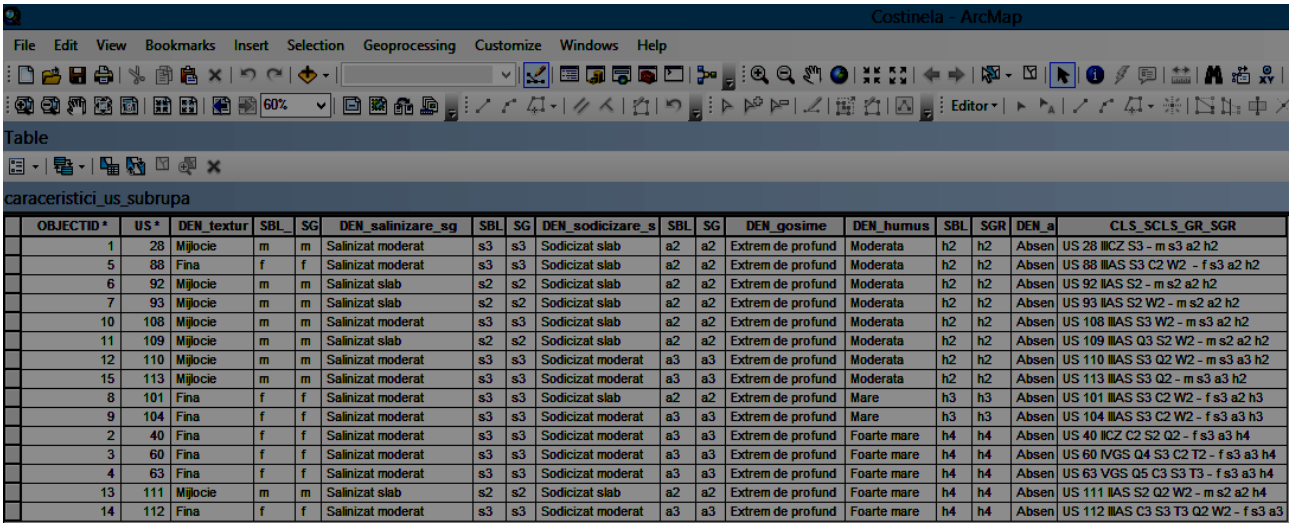
As we said earlier, soil units are grouped in relation to the suitability to field crops or other uses in classes, subclasses and groups (Table 1), using the limiting factors for a given production uses criterion [3]. The performance class suitability it is given by the intensity of the largest soil limitation. The subclass is determined by the nature of limitation or associated limitations. The group is a subdivision within subclass of limitations caused by different intensities.

Table 1 Determination of class, subclass and group at arable suitability for US 63

Characteristics of US in order to establish suitability of the arable class	**63**		
	Name	**Symbol**	**Class**
Soil texture in upper horizon	Clay	a	III
Rainfall	Middle	P05	I
Volum edafic	Excessive	V0	I

Soil salinization	Degree of salinization ((irrigated land)		Moderate	S3	III
	Degree of sodicity (irrigated land)		Moderate	A3	III
Acidity			Slightly alkaline	A07	-
Degree of settling			Powerful settling	t6	III
Anthropogenic degradation			Unpolluted	0	I
Coverage of terrain with rocks and boulders			Not the case	-	I
The average annual temperature			Verty high	T11	I
Slope			Horizontally	P01	I
Surface erosion	Risk		Absent	-	I
	Degree of damage to the land surface		Absent	e00	I
Degrees of erosion in depth			Absent	r00	I
Landslide			Absent	f00	I
The degree of unevenness of the territory			Uniform territories	U0	I
Excess moisture	Underground water	The depth of the groundwater level	Verry small	Q3	III
		Lateral drainage of groundwater	Moderate	M	-
		The degree of soil gleyzation	Excessive gleyied	G6	V
	Surface water	The intensity of excess moisture	Absent	-	I
Excess moisture infiltration into the soil from the side, on the mountains			Absent	l1	I
Floodability			Unflooded	-	I

Subgroups of suitability are subdivisions within groups, differentiated by soil and terrain characteristics, which establishes the choice for improvement solutions and crop technologies (Fig. 2).



OBJECTID *	US *	DEN_textur	SBL_	SG	DEN_salinizare_sg	SBL	SG	DEN_sodicizare_s	SBL	SG	DEN_gosime	DEN_humus	SBL	SGR	DEN_a	CLS_SCLS_GR_SGR
1	28	Mijocie	m	m	Salinizat moderat	s3	s3	Sodicizat slab	a2	a2	Extrem de profund	Moderata	h2	h2	Absen	US 28 IIICZ S3 - m s3 a2 h2
5	88	Fina	f	f	Salinizat moderat	s3	s3	Sodicizat slab	a2	a2	Extrem de profund	Moderata	h2	h2	Absen	US 88 IIIAS S3 C2 W2 - f s3 a2 h2
6	92	Mijocie	m	m	Salinizat slab	s2	s2	Sodicizat slab	a2	a2	Extrem de profund	Moderata	h2	h2	Absen	US 92 IIAS S2 - m s2 a2 h2
7	93	Mijocie	m	m	Salinizat slab	s2	s2	Sodicizat slab	a2	a2	Extrem de profund	Moderata	h2	h2	Absen	US 93 IIAS S2 W2 - m s2 a2 h2
10	108	Mijocie	m	m	Salinizat moderat	s3	s3	Sodicizat slab	a2	a2	Extrem de profund	Moderata	h2	h2	Absen	US 108 IIIAS S3 W2 - m s3 a2 h2
11	109	Mijocie	m	m	Salinizat slab	s2	s2	Sodicizat slab	a2	a2	Extrem de profund	Moderata	h2	h2	Absen	US 109 IIIAS Q3 S2 W2 - m s2 a2 h2
12	110	Mijocie	m	m	Salinizat moderat	s3	s3	Sodicizat moderat	a3	a3	Extrem de profund	Moderata	h2	h2	Absen	US 110 IIIAS S3 Q2 W2 - m s3 a3 h2
15	113	Mijocie	m	m	Salinizat moderat	s3	s3	Sodicizat moderat	a3	a3	Extrem de profund	Moderata	h2	h2	Absen	US 113 IIIAS S3 Q2 - m s3 a3 h2
8	101	Fina	f	f	Salinizat moderat	s3	s3	Sodicizat slab	a2	a2	Extrem de profund	Mare	h3	h3	Absen	US 101 IIIAS S3 C2 W2 - f s3 a2 h3
9	104	Fina	f	f	Salinizat moderat	s3	s3	Sodicizat moderat	a3	a3	Extrem de profund	Mare	h3	h3	Absen	US 104 IIIAS S3 C2 W2 - f s3 a3 h3
2	40	Fina	f	f	Salinizat moderat	s3	s3	Sodicizat moderat	a3	a3	Extrem de profund	Foarte mare	h4	h4	Absen	US 40 IICZ C2 S2 Q2 - f s3 a3 h4
3	60	Fina	f	f	Salinizat moderat	s3	s3	Sodicizat moderat	a3	a3	Extrem de profund	Foarte mare	h4	h4	Absen	US 60 IVGS Q4 S3 C2 T2 - f s3 a3 h4
4	63	Fina	f	f	Salinizat moderat	s3	s3	Sodicizat moderat	a3	a3	Extrem de profund	Foarte mare	h4	h4	Absen	US 63 VGS Q5 C3 S3 T3 - f s3 a3 h4
13	111	Mijocie	m	m	Salinizat slab	s2	s2	Sodicizat slab	a2	a2	Extrem de profund	Foarte mare	h4	h4	Absen	US 111 IIAS S2 Q2 W2 - m s2 a2 h4
14	112	Fina	f	f	Salinizat moderat	s3	s3	Sodicizat moderat	a3	a3	Extrem de profund	Foarte mare	h4	h4	Absen	US 112 IIIAS C3 S3 T3 Q2 W2 - f s3 a3

Fig. 2 Determination of arable suitability subgroup

For the 15 soil units from the study perimeter were determined the arable suitability categories [2], which are shown in fig. 3.

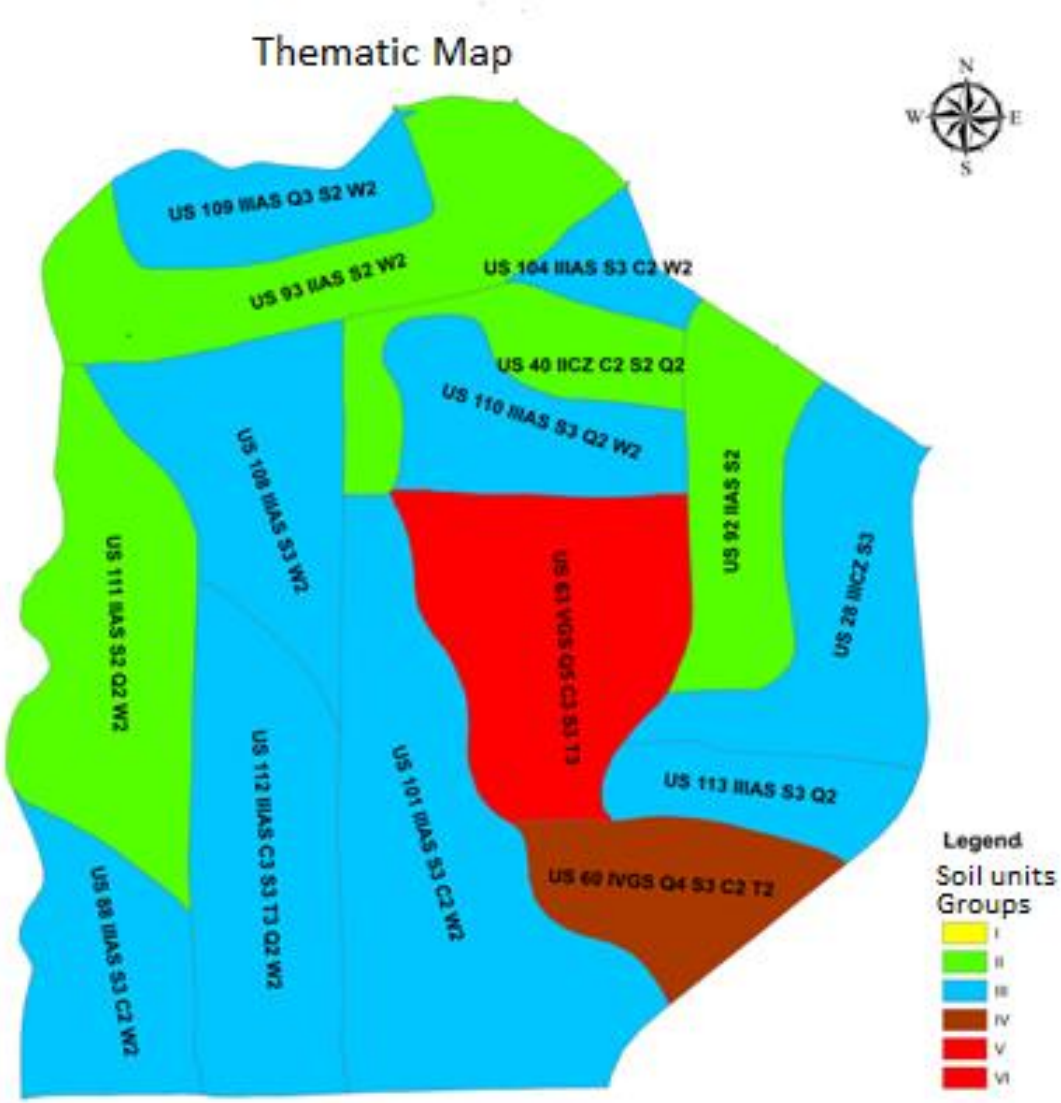


Fig. 3 Arable suitability classes of analyzed soils

Soils limitations and shortcomings are given by analysis of suitability categories and are presented in fig. 4.

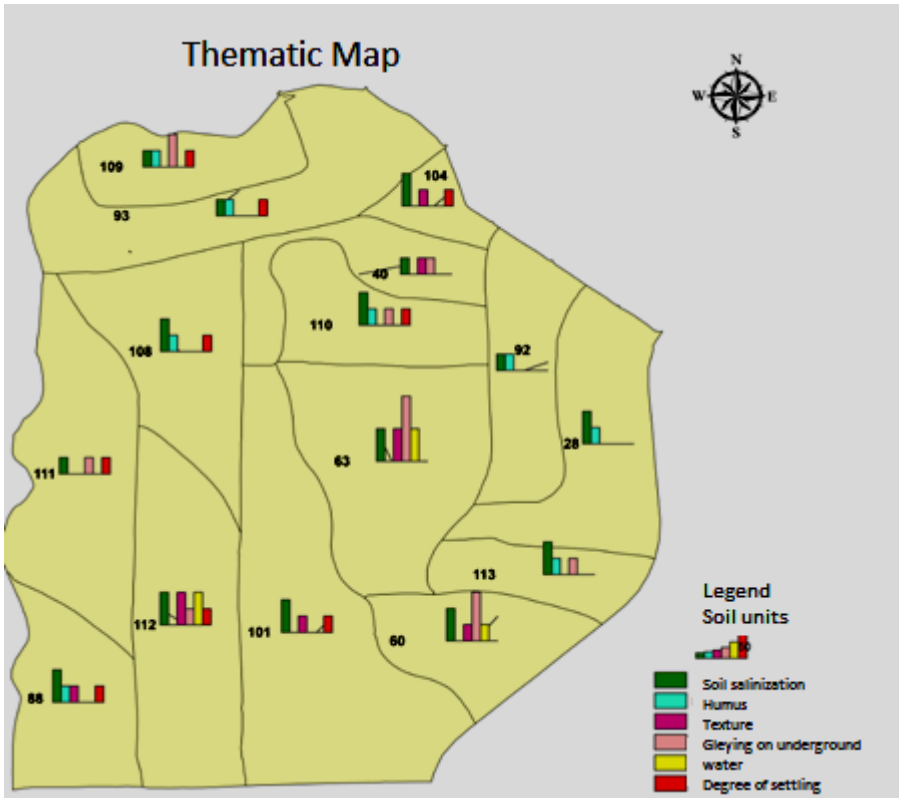


Fig. 4 Terrains limitations and weaknesses

These limitations or deficiencies associated to the terrains have different intensity levels. Fig. 5 presents a database query after limiting the terrains due to salinisation, i.e. after moderate salinisation level.

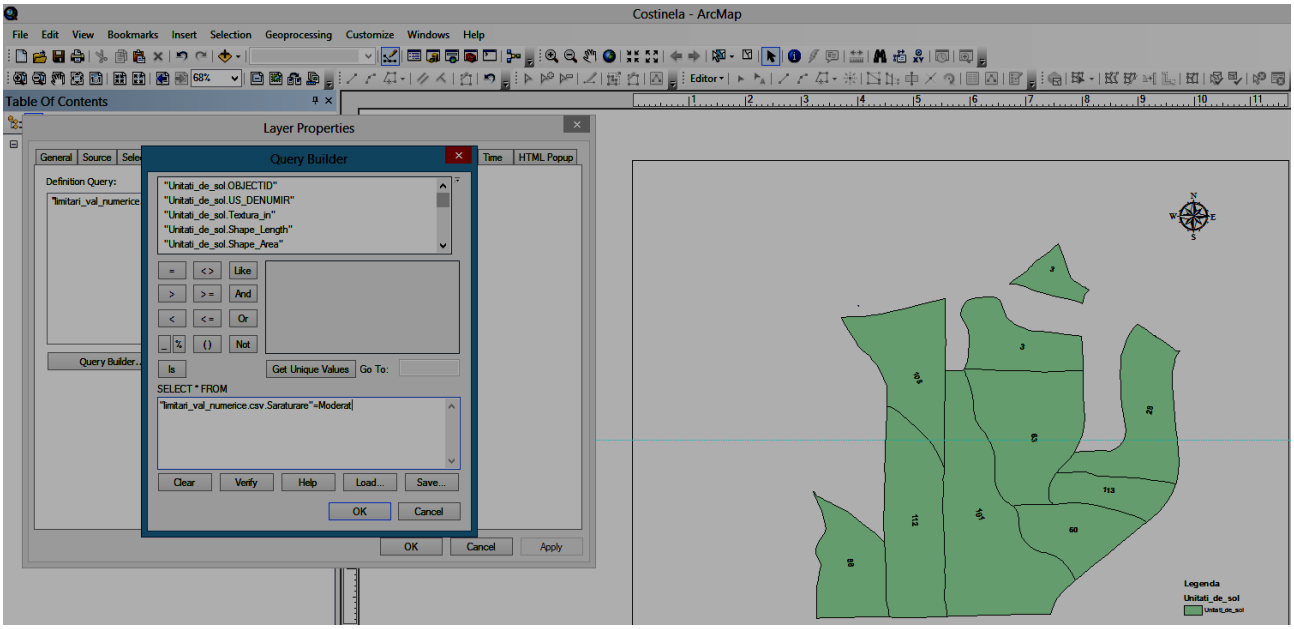


Fig. 5 Thematic map with moderate salinisation level

Also, a query is made by the intensity given by the ground water limitation in Fig. 6.

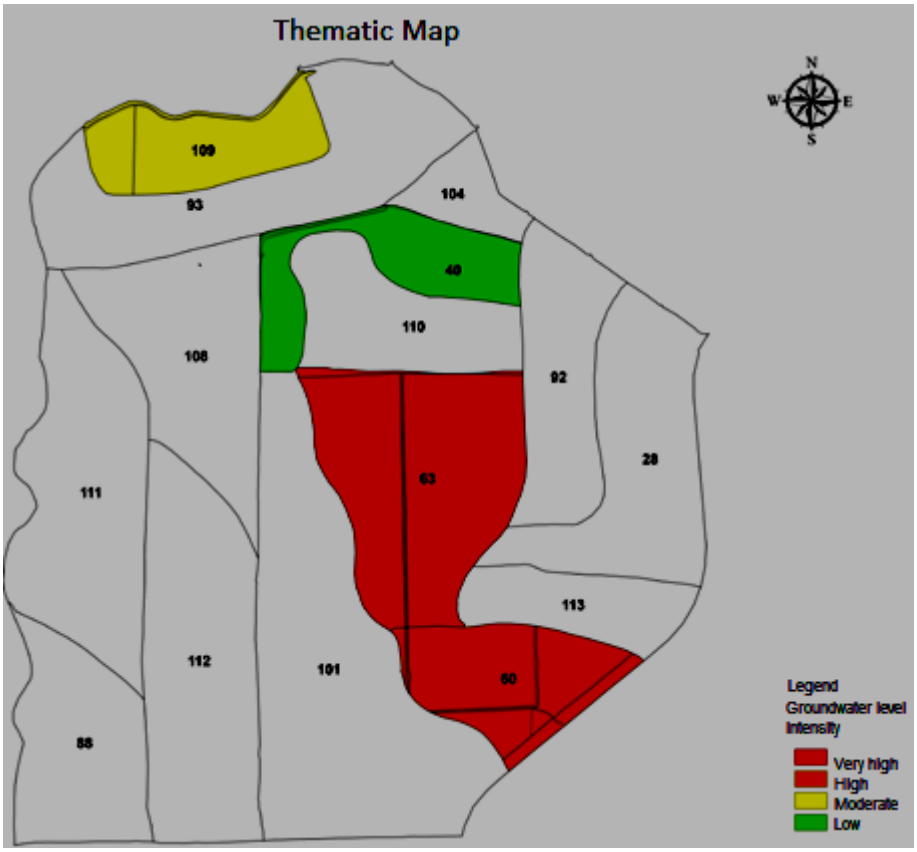


Fig. 6 Groundwater level intensity

Subject to the terrains limitations and shortcomings are recommended mitigation measures that can be used in order to increase productivity. Naturally, different intensities of these limitations lead to different intervention needs on the terrains.

Thus, on salty soils, it is recommended to wash the salts with irrigation works and on the terrains affected by excess moisture from the surface, gleyzation and groundwater level are recommended drainage works.

On the soil units that are strong, moderate or weak compacted, deep loosening is required and on soil units of which humus reserve is less than 160 t/ha ameliorative fertilization is necessary (Fig. 7).

4. Conclusions

From the perspective of economic development of a geographical area, a soil analysis is required, seen both as a means of agriculture production and also as a natural resource whose regeneration is conditioned by the use.

Terrains limitations or restrictions are properties that reduce the use of terrains for a particular crop or use and are given by the nature and intensity of the restrictive factor or factors. To improve some physical, chemical or biological properties of soils one can intervene by improvement works (land improvement works or agricultural-pedological improvement works). Intervention, however, requires careful consideration of all related soil properties.

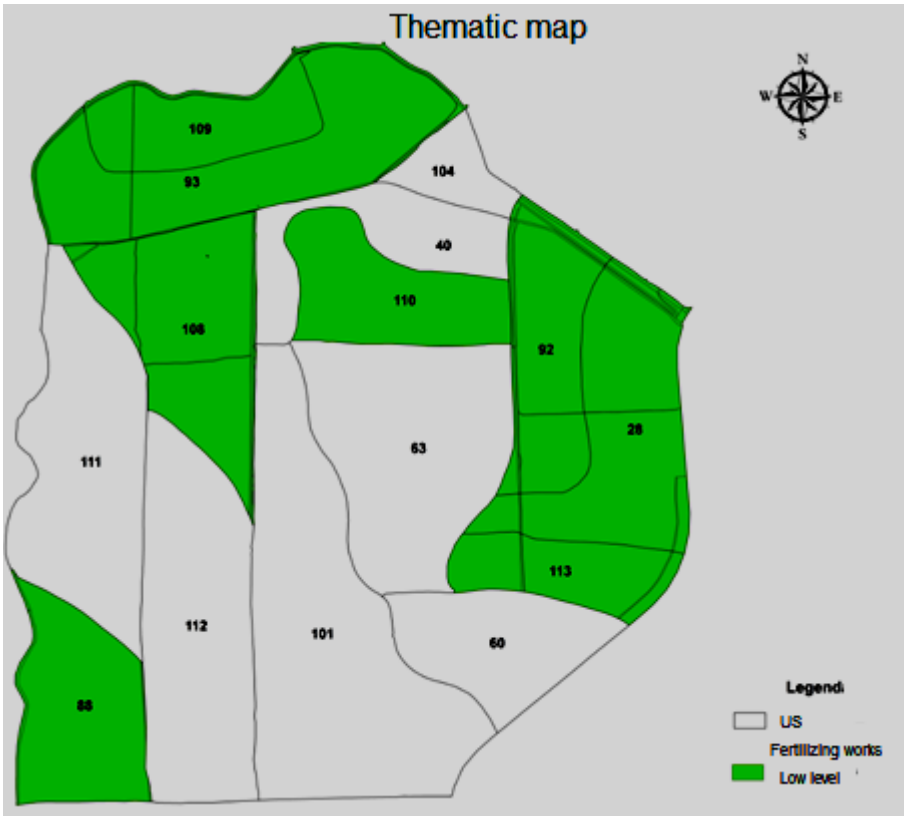


Fig. 7 Thematic map with low level of intervention by fertilizing works

5. References

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