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Evaluation of Soil Suitability for Regional Planning in Croatia

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SUMMARY

Soil suitability map with scale of 1:300 000 have been printed in the Republic of Croatia first time, based on the data of Basic Soil Map with scale of 1:50 000 and other cartographical surveys, made in the last 30 years. A group of authors has made an evaluation of soil cultivation suitability in accordance with the modified criteria of land evaluation (FAO, 1976. and Ž.Vidaček, 1976 and 1981). A total of 65 soil units of automorphic, hydromorphic, halomorphic and subaquatic soils have been evaluated according to the suitability degree and to dominating kinds of limitations for an intensive use in agriculture, respectively. As per suitability degree, possibilities of use, needs of land reclamation and protection there are in Croatia 25657,55 km² or 53,8% soils of different suitability classes (suitable, moderately suitable, restricted suitable), 6880.27 km² or 14,4% temporarily unsuitable and even 15181.43 km² or 31,8% soils permanently unsuitable for an intensive use in agricultural production. Rocky surfaces mainly located in the Karst areas cover 7964.55 km². Soil suitability map for cultivation has multiple significance. At national and regional level, it can serve for planning of a sustainable development and protection, as well as cultivation of land, then as a base for development of agriculture and forestry, for regional planning, protection of human environment, making of projects for main roads, gas pipelines, waterworks and other urban and industrial plants. Therefore, protection of soil should not be in competence of one user only, but of all those who must keep in mind that a sustainable use and well organized protection of soil is a base for human existence.

KEY WORDS

land evaluation, land use, soil protection, soil suitability

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Procjena pogodnosti tala Hrvatske u funkciji prostornog planiranja

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SAŽETAK

Prvi puta u Republici Hrvatskoj štampana je Namjenska pedološka karta mjerila 1:300 000 na temelju podataka Osnovne pedološke karte mjerila 1:50 000 i drugih kartografskih prikaza rađenih posljednjih 30-tak godina. Grupa autora izradila je procjenu pogodnosti tla za obradu-kultivaciju prema modificiranim kriterijima procjene zemljišta, FAO, 1976. i Vidaček, Ž., 1976. i 1981. Ukupno 65 pedosistematskih jedinica automorfni, hidromorfni, halomorfni i subakvalni tala je procijenjeno prema stupnju pogodnosti, odnosno prema dominantnim vrstama ograničenja za intenzivno korištenje u poljodjelstvu. Prema stupnju pogodnosti, mogućnostima korištenja, potrebama uređenja i zaštite tla u Hrvatskoj ima ukupno 25657.55 km² ili 53.8% tala različitog stupnja pogodnosti (pogodnih, umjereno pogodnih i ograničeno pogodnih), privremeno nepogodnih tala ima 6880.27 km² ili 14.4%, a čak 15181.43 km² ili 31.8% trajno nepogodnih tala za intenzivno korištenje u primarnoj biljnoj-poljodjelskoj proizvodnji. Stjenovite površine koje se nalaze uglavnom u krškom predjelu iznose 7964.55 km². Namjenska pedološka karta pogodnosti tala za obradu ima višestruko značenje. Na nacionalnoj i regionalnoj razini ona može poslužiti planiranju održivog razvoja i zaštite, te uređenju tla, zatim kao podloga za razvoj poljodjelstva i šumarstva, u prostornom planiranju, zaštiti čovjekova okoliša, izradi projekata magistralnih putova, cesta, plinovoda, vodovoda i drugih urbanih i industrijskih objekata. Stoga, briga o tlu nije u nadležnosti samo jednog korisnika, nego svih, koji moraju voditi računa o tome da je održivo korištenje i organizirana zaštita tla osnova opstanka čovječanstva.

KLJUČNE RIJEČI

procjena zemljišta, uporaba zemljišta, zaštita tla, pogodnost tla.

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INTRODUCTION

In the middle of eighties Ž. Vidaček and F. Vančina (1985) have discussed in detail the possibilities of using soil suitability maps or applied soil maps in the field of regional planning. In 1985 FAO method for evaluation of soil/land was proposed with making of suitability maps for use in agriculture and forestry, as well as for other land users, with the primary goal of an economic, sustainable planning of land and an organized integral soil protection. It was the time of organized activities in Slovenia and Croatia within the scope of Working Association Alpe-Adria, concretely - it's Commission for Regional Planning and Protection of Human Environment.

Since 1994 regional planning in Croatia have been regulated by a law, determining the measures and documentation for realizing regional planning, respectively. An integral approach to the regional planning covers familiarity, check up and evaluation of land development possibilities, as well as making documents for regional planning.

By the documents of regional planning a purposeful organization and use of land, as well as the rules and lines for reclamation and protection of State-own and district-own lands are determined.

Soil maps of various scales, appropriate to the planning level, represent a scientific and professional base for the strategy, programs and plans of regional planning in Croatia. The soil suitability map with scale 1:300.000, with legend and instructions for use may be a base for regional planning at national and/or regional level.

properties - depth, debris-skeletal, acidity, salinity/alkalinity, texture/verticity, water capacity, etc. corresponding ectomorphological and space properties are evaluated, such as rockiness, inclination, flood and/or stagnant surface waters and the drainage as the soil quality - expression for soil humidity regime.

With regard to the topicality of soil pollution and protection problems, degree of soil sensitiveness against chemical pollutants was additionally evaluated, in accordance with the criteria for evaluation of vulnerability - degradation processes of European soils, Batjes N.H., Bridge, E.M. et al, 1991, originally to Fraters, 1994.

Orders determine suitability (S) or unsuitability (U) of soil for cultivation, **classes** determine suitability degree or S-1, good, cultivable soils, S-2 moderately limited cultivable soils, S-3 limited cultivable soils, U-1 temporarily unsuitable for cultivation and U-2 permanently unsuitable soils for cultivation. **Subclasses** of soil suitability and unsuitability determine the types and intensity of limitations as follows:

Basic soil map of Republic of Croatia with scale 1:50.000 was the main source of pedological data for making soil suitability map with scale 1:300.000.

Working methods are based on the info technology, and are in accordance with the methods of Croatian geographical and land-info system (GIZIS) - similar with GIS, also actual in the most European countries (Oldeman, L.R., 1994; Várallyay, G., Szabó, J., Pásztor, L., Michéli, E., 1994).

Rockiness (St)

st₁ > 50% rock
st₂ < 50% rock

Debris-skeletal (sk)

sk₁ > 50% skelet
sk₂ < 50% skelet

Verticity (vt) > 30% clay

Stoniness = ka

Soil acidity (k) < 5,5 pH in water

Terrain inclination (n)

n > 15 and/or 30%

Water surplus

pv = flood waters
su = permanently under water
v = stagnant surface waters
V = high level of underground water

Salinity (sa)

Erosion = e

e₁ = high intensity
e₂ = medium intensity
e₃ = low intensity

Degree of soil sensitiveness against chemical pollutants (p)

p₁ = weak sensitiveness
p₂ = moderate sensitiveness
p₃ = strong sensitiveness

Drainage (dr)

dr₀ poor
dr₁ very poor
dr₂ excessive

Soil depth (du)

du₁ < 30 cm
du₂ < 60 cm

Alkalinity (na)

Retention water

capacity (kv) < 25% vol.

METHODS AND MATERIALS USED

Evaluation of soil suitability for cultivation in Croatia, space arrangement of which is shown on the map with scale 1:300.000 is in accordance with the modified criteria for soil evaluation (FAO, 1976 and Vidaček Ž., 1976 and 1981). In addition to the relevant soil

Digitalization of contours of cartographical soil units from the Basic soil map was made by hand, with a digitalizator Calcomp by means of program packet AutoCAD 13. Data entered into Access data base are connected with the data processed in the Arcinfo program, and search of the data base is made by the program packet ArcWiew 3.0.

Table 1. Soil units in Croatia

Name and code, according to Croatian classification	For great groups according to FAO, 1990.
Lithosol on limestone and dolomite (1)	Leptosols
Arenosol anthropogenized (2)	Arenosols
Rhegosol on loess (3), on marl (4), on flysch (5)	Regosols
Colluvial with prevailing rock detritus (6), with prevailing of soil material (7)	Regosols
Calcomelanosol (8)	Leptosols
Rendzina on marl (9), on flysch (10), on soft limestones (11), on gravel (12), on worn-out limestones (13), on dolomite (14)	Leptosols
Ranker on sand (15), on gravel (16), on sandstones, conglomerates and schists (17), on quartz (18)	Leptosols
Chernozem on loess typical (19), semigleyic (20)	Phaeozems
Vertisol on marl (21), on soft limestones (22)	Vertisols
Cambisol eutric on loess (23), on holocene sediments (24), on sand (25), on lacustrine sediments (26), on igneous rocks (27)	Cambisols
Cambisol distric on loess (28), on clastites (29), on sand (30), on relict Terra rossa (31), on sandstones, conglomerates and schists (32), on metamorphic rocks (33), on igneous rocks (34)	Cambisols
Terra rossa, shallow and medium deep (35), deep and luvic (36)	Cambisols
Calcocambisol on dolomite (37), on limestone, shallow and medium deep (38), on limestone, deep (39)	Cambisols
Luvisol on loess, typical (40), on loess, pseudogleyic (41), on loess sediments (42), typical on loams (43), on limestone and dolomite (44)	Luvisols, Lixisols
Brown podzolic soil (45)	Podzols
Podzol (46)	Podzols
Rigosol on loess (47), on marl (48), on colluvium (49), on karts (50)	Anthrosols
Pseudogley on level terrain (51), on sloping terrain (52)	Podzoluvisols
Fluvisol gleyed (53), non-gleyed (54), semigley (55)	Fluvisols
Pseudogley-gley, partly ameliorated (56)	Podzoluvisols
Eugley, partly ameliorated (57), gleyic vertic (58)	Gleysols
Humogley, partly ameliorated (59), vertic (60)	Gleysols
Low peat (61)	Histosols
Hydroameliorated with drainage (62)	Anthrosols
Solonetz (63)	Solonetz
Solonchak (64)	Solonchaks
Gyttja (65)	Gleysols

RESULTS AND DISCUSSION

Land reclamation based on the Law of regional planning of Republic of Croatia, 1994, covers the principles of a sustainable development, an economic use and protection of soil and establishes a system of information on the soil, for purpose of use and protection of land, total continental surface of which amounts to 56.610 km².

For purpose of following soil conditions, authorized bodies keep records, by which a purposeful organization and use of soil, as well as the rules and lines for reclamation and protection of State-own and district-own lands are determined.

Soil maps with various scales, appropriate to the planning level, represent a scientific and professional base for the strategy, programs and plans of land reclamation in Croatia. The soil suitability map with scale 1:300.000, with legend and instructions for use may be a base for regional planning - land reclamation at national and/or regional level.

A total of 65 soil units of automorphic, hydromorphic, halomorphic and subaquatic soils have been evaluated according to the suitability degree and to dominating kinds of limitations, respectively, for an intensive land use in agriculture, which is organized in Croatia on total 23.360 km² of arable land, tables 1 and 2. The area of 14.040 km² is covered by arable land and gardens, 620 km² by orchards, 550 km² by vineyards, 3.200 km² by meadows, 7.710 km² by grasslands, and 240 km², by reeds, pools and fish-ponds. Forests cover 20.793 km². Rest, 12.457 km² are unfruitful - unproductive areas for primary plant production.

Soil units of each pedocartographic units are evaluated according to degree of suitability for cultivation, concerning possibility for regional planning, land reclamation and soil protection in Croatia, table 3.

In respect to soil suitability degree, possibilities of land use, land cultivation and soil protection there are in Croatia total of 25657,55 km² suitable, moderately

Table 2. Soil suitability for intensive farming

Orders	Suitability classes degree	Suitability subclasses, limitations*	Soil units - name and code
S Suitable	S-1 Suitable	p ₁	Chernozem on loess typical (19); Chernozem semigleyic (20); Cambisol eutric on holocene sediments (24); Fluvisol non-gleyic (54); Fluvisol semigleyic (55)
	S-2 Moderately suitable	sk ₁ , n, p ₂	Colluvial with prevailing of soil materials (7)
		n, e, p ₂	Cambisol eutric on loess (23); Luvisol on loess, typical (40), Rigosol on loess (47)
		dr ₀	Hydroameliorated with drainage (62)
		st ₂ , p ₁	Terra rossa deep and luvis (36)
	S-3 Restricted suitable	dr ₀ , p ₃	Luvisol on loess, pseudogleyic (41)
		kv, p ₃	Arenosol anthropogenized (2); Cambisol eutric on sand (25)
		e, p ₁	Rhegosol on loess (3) and on marl (4)
		n, du ₂ , p ₁	Rendzina on marl (9);
		du ₁ , kv, p ₃	Ranker on sand (15)
		vt, n, p ₁	Vertisol on marl (21); Cambisol eutric on lacustrine sediment (26); Vertisol on soft limestones (22)
		n, k, p ₃	Cambisol distric on loess (28)
		k, sk ₂ , p ₃	Cambisol distric on clastites (29)
kv, k, p ₃		Cambisol distric on sand (30)	
st ₂ , k, p ₃		Cambisol distric on relict Terra rossa (31)	
n, e, p ₂		Luvisol on loess sediments (42) and typical on loam (43); rigosol on marl (48)	
sk ₂ , p ₂		Rigosol on colluvium (49)	
U Unsuitable	U-1 Temporarily unsuitable	sk ₁ , du ₂ , p ₂	Rigosol on karst (50)
		v, dr ₀ , p ₃	Pseudogley on level terrain (51)
		v, dr ₀ , n, p ₃	Pseudogley on sloping terrain (52)
		sk ₂ , p ₃	Colluvial with prevailing rock detritus (6)
		n, du ₂ , p ₁	Rendzina on flysch (10)
		sk ₂ , du ₂ , p ₁	Rendzina on gravel (12)
		sk ₂ , du ₁ , k, p ₃	Ranker on gravel (16)
		p, V, p ₂	Fluvisol gleyic (53)
		v, V, dr ₀ , p ₃	Pseudogley-gley (56)
		v, V, dr ₁ , p ₃	Eugley (57)
		V, dr ₁ , p ₃	Humogley (59)
		V, p ₃	Low peat (61)
	na, p ₃	Solonetz (63)	
sa, p ₃	Solonchak (64)		
su	Gyttja (65)		
U-2 Permanently unsuitable	ka, st, dr ₂ , p ₃	Lithosol on limestone and dolomite (1)	
	e, n, p ₂	Rhegosol on flysch (5)	
	st ₂ , du ₁ , p ₁	Calcomelanosol (8)	
	n, du ₂ , p ₁	Rendzina on soft limestone (11)	
	n, sk ₂ , p ₁	Rendzina on worn-out limestone (13)	
	du ₁ , p ₁	Rendzina on dolomite (14)	
	n, du ₁ , k, p ₃	Ranker on sandstones, conglomerates and schists (17)	
	n, du, sk, k, p ₃	Ranker on igneous rocks (18)	
	n, st ₂ , du ₂ , p ₁	Cambisol eutric on igneous rocks (27)	
	n, sk ₁ , k, p ₃	Cambisol distric on sandstones, conglomerates and schists (32) and on igneous rocks (34)	
	n, sk ₂ , k, p ₃	Cambisol distric on metamorphic rocks (33)	
	st ₁ , du ₂ , p ₁	Terra rosa shallow and medium deep (35)	
st ₁ , n, p ₁	Calcocambisol on dolomite (37), on limestone, shallow and medium deep (38) and deep (39)		
st ₁ , p ₂	Luvisol on limestone and dolomite (44)		
k, sk ₂ , p ₃	Brown pozolic soil (45); Podzol (46)		
v, V, dr ₁ , vt, p ₃	Eugley vertic (58); Humogley vertic (60)		

*Note: sign explanation see in chapter 1.

suitable, limited suitable soils for an intensive use, then 6880.27 km² temporarily unsuitable and even 15181.43 km² soils permanently unsuitable for an

intensive use in agricultural production. Rocky surfaces mainly located in the Karst areas cover 7964.55 km², table 4.

Table 3. The legend of soil suitability map of Croatia

Suitability orders and classes	Suitability subclasses*	No	Soil mapping units		Area ha
			Dominant soil units	Others	
1	2	3	4	5	6
S-1 Suitable	p ₁	1	Chernozem on loess	Cambisol eutric, Rhegosol on loess	19.700
		2	Chernozem on loess, semigleyic and typical	Humogley, Cambisol on loess, Rigisol on loess	34.090
		3	Cambisol eutric	Luvisol, Humofluvisol, Eugley	73.503
		4	Humofluvisol	Eugley, Fluvisol	33.732
		5	Fluvisol notflooded	Humofluvisol, Fluvisol flooded, Eugley	105.697
	p ₂	6	Cambisol eutric on loess	Chernozem on loess, Luvisol on loess	33.648
S-2 Moderately suitable	n, e, p ₂	7	Rigisol on loess	Rhegosol, Cambisol eutric on loess	26.835
		8	Luvisol on loess	Pseudogley, Cambisol eutric, Eugley, Colluvial soil	200.783
	dr ₀ , p ₁	9	Luvisol on loess, semigleyic	Pseudogley on level terrain, Eugley mineral, Pseudogley-gley, Cambisol eutric on loess	110.125
		10	Luvisol on loess, pseudogleyic	Luvisol typical, Pseudogley, Eugley, Cambisol distric on loess	206.045
	dr ₀ , p ₃	11	Luvisol typical on marl and soft limestone	Rendzina calcareous, Pseudo-gley on sloping terrains, Cambisol eutric, Rhegosol, Colluvial with prevailing of soil material, Eugley	63.344
		12	Hydroameliorated soil	Fluvisol	20.035
	dr ₀ , v, p ₁ sk ₂ , n, p ₂	13	Colluvial with prevailing of soil material	Eugley, Humofluvisol, Pseudogley	13.559
		st ₂ , p ₁	14	Terra rossa, luvic	Cambisol distric on relict Terra rossa, Calcocambisol, Luvisol acric, Calcomelanosol
	15		Terra rossa, luvic and typical, deep	Calcocambisol on limestone, Calcomelanosol	120.883
	S-3 Restricted suitable	e, p ₁	16	Rhegosol on loess	Colluvial with prevailing of soil material, Eugley, Cambisol eutric, Chernozem
n, du ₂ , p ₁		17	Rendzina on marl and soft limestone	Rigisol, Rhegosol, Luvisol on marl or loess, Cambisol eutric	261.464
		18	Luvisol typical on loams	Cambisol distric, Pseudogley on sloping terrain, Ranker, Rendzina on limestone or marl	51.911
n, k, p ₃		19	Cambisol distric on loess and holocene sediments	Luvisol, Pseudogley, Rendzina, Eugley, Cambisol eutric	105.804
		20	Vertisol on marl and soft limestone	Anthropogenic soils, Rendzina on flysch, Rhegosol, Calco-cambisol on limestone	4.789
vt, n, p ₁		21	Cambisol eutric flysch or soft limestone	Rendzina on marl, Luvisol, Calcocambisol on limestone and dolomite, Rhegosol	31.725
kv, p ₃		22	Cambisols eutric and distric on sand	Ranker regolithic, Luvisol on sand, Arenosol, Pseudogley on level terrain	3.335
du ₁ , kv, p ₃		23	Ranker on sand	Cambisol distric, Luvisol, Rhegosol on sand, Pseudogley on level terrain	584

Table 3. The legend of soil suitability map of Croatia

Suitability orders and classes	Suitability subclasses*	No	Soil mapping units		Area ha
			Dominant soil units	Others	
1	2	3	4	5	6
S-3 Restricted suitable	st ₂ , n, p ₁	25	Calcocambisol on dolomite	Rendzina on dolomite, Luvisol on dolomite, Cambisol distric on relict Terra rossa	59.996
	v, dr ₀ , p ₃	26	Pseudogley on level terrain	Pseudogley-gley, Luvisol on loess, Eugley, Humogley	145.907
		27	Pseudogley on level terrain	Pseudogley on sloping terrain, Cambisol distric on loess, Luvisol on loess, Eugley	134.971
		28	Pseudogley on sloping terrain	Pseudogley on level terrain, Luvisol on loess, Cambisol distric, Eugley, Colluvial soil	231.314
	v, dr ₀ , n, p ₃	29	Pseudogley on sloping terrain	Cambisol distric, Luvisol on loess, Rendzina on marl, Cambisol eutric, Eugley	81.991
	sk ₁ , du ₂ , p ₂	30	Anthropogenic soil of karst	Calcocambisol on limestone and dolomite, Terra rossa, Calcomelanosol	104.168
	sk ₂ , p ₂	31	Anthropogenic soils on flysch and colluvium	Rendzina on flysch, Rhagosol, Eugley, Pseudogley on sloping terrain, Colluvial soil	85.624
	st ₂ , p ₂	32	Luvisol typical and acric on limestone and dolomite	Cambisol distric on relict Terra rossa, Terra rossa, typical and luvic, Rendzina on dolomite	53.327
	st ₂ , k, p ₃	33	Cambisol distric on relict Terra rossa	Luvisol acric and typical on limestones and dolomite, Terra rossa, Rendzina on dolomite, Calcocambisol	73.302
	U-1 Temporarily unsuitable	sk ₁ , p ₃	34	Colluvial soil with prevailing rock detritus	Lithosol, Rendzina, Calco-cambisol on limestone, Calcomelanosol
sk ₂ , du ₂ , p ₁		35	Rendzina on gravel	Cambisol, Anthropogenic soils, Lithosol, Colluvial soil	51.827
sk ₂ , du ₁ , k, p ₃		36	Ranker on gravel	Cambisol distric, Brawn podzolic soil	10.139
V, v, dr ₁ , p ₃		37	Eugley	Histosol, Subaquatic soil	1.184
V, p ₃		38	Low peat	Eugley, Humogley	4.941
sa (na), p ₃		39	Halomorphic soils	Pseudogley-gley, Humogley, Eugley	1.063
su		40	Gyttja	Fluvisol	254
pv, V, p ₂		41	Fluvisol	Eugley	51.026
V, dr ₁ , p ₃		42	Humogley partly ameliorated	Eugley, Pseudogley on level terrain	57.385
		43	Eugley partly ameliorated	Colluvial with prevailing of soil material, Rendzina on prolu-vium, Pseudogley on level terrain, Pseudogley-gley	135.895
V, v, dr ₁ , p ₃		44	Eugley partly ameliorated	Humofluvisol, Humogley, Fluvisol	215.736
		45	Eugley partly ameliorated	Pseudogley-gley, Pseudogley on level terrain, Humogley vertic, Luvisol	62.940
		46	Eugley partly ameliorated	Eugley vertic, Humofluvisol	27.816
V, v, dr ₀ , p ₃	47	Pseudogley-gley, partly	Pseudogley on level terrain, Eugley,	58.177	

Table 3. The legend of soil suitability map of Croatia

Suitability orders and classes	Suitability subclasses*	No	Soil mapping units		Area ha
			Dominant soil units	Content and structure Others	
1	2	3	4	5	6
U-2 Permanently unsuitable	n, sk ₂ , p ₁	49	Rendzina on skeletal limestone	Calcocambisol on limestone,	43.141
	n, sk ₂ , k, p ₃	50	Cambisol distric on metamorphic and clastic rocks	Calcomelanosol, Terra rossa, Lithosol Ranker, Luvisol	106.407
		51	Cambisol distric on acid igneous and clastic rocks	Luvisol, Ranker	4.921
	n, sk ₂ , k, p ₃	52	Cambisol distric on conglomerates, sandstones and schists	Brown podzolic soil, Podzol, Ranker regolith, Calcocambisol on limestone	9.100
	n, st ₂ , du ₂ , p ₁	53	Cambisol eutric on basic igneous rocks	Ranker eutric, Cambisol distric, Luvisol, Rendzina	32.024
	ka, st ₁ , dr ₂ , p ₃	54	Lithosol on limestone and dolomite	Calcomelanosol, Rendzina, Calcocambisol on limestone, Terra rossa	80.826
	st ₁ , du ₂ , p ₁	55	Terra rossa shalow and medium deep	Calcocambisol on limestone,	223.467
		56	Calcocambisol on limestone	Calcomelanosol, Anthropoge-nic soils Calcomelanosol, Rendzina, Luvisol on limestone, Terra rossa, Rigosol of karst, Cambi-sol eutric, Rhegosol on marl	527.027
	st ₁ , n, p ₁	57	Calcocambisol on limestone	Terra rossa typical and luvic, Calcomelanosol, Rendzina on worn-out limestone, Luvisol on limestone, Lithosol, Rigosol	328.891
		58	Calcocambisol on limestone	Luvisol on limestone, Calcomelanosol, Rendzina, Colluvial soil	167.214
	st ₁ , p ₂	59	Luvisol on limestone and dolomite	Calcocambisol on limestone, Rendzina on limestone, Calcomelanosol	36.363
	st ₂ , n, p ₁	60	Calcocambisol on limestone	Anthropogenic soils, Terra rossa, Calcomelanosol, Rendzina	8.728
	st ₂ , du ₁ , p ₁	61	Calcomelanosol	Calcocambisol, Rendzina on worn-out limestone, Luvisol on limestone and dolomite	273.275
		62	Rendzina on dolomite and limestone	Calcocambisol on limestone, Luvisol on limestone, Calcomelanosol	224.619
		63	Brown podzolic soil	Cambisol distric, Podzol, Ranker regolith	815
	k, sk ₂ , p ₃	64	Podzol	Brown podzolic soil, Cambisol distric on conglomerates and sandstones, Ranker regolith	442
v, V, dr ₁ , vt, p ₃	65	Eugley vertic	Eugley nonvertic, Humogley, Pseudogley-gley, Histosols	158.304	
	66	Rivers, lakes, fishponds			
	67	Settlements			
TOTAL MAPPED AREA					5.564.086

*Note: sign explanation see in chapter 1.

CONCLUSIONS

Soil represents a limited and conditionally renewable natural resource of each country. It is of special strategic interest and importance, therefore it must be rationally used and appropriately protected. For purpose of following land conditions, authorized bodies keep documentation of land, among which is soil suitability map of Republic of Croatia, with scale 1:300.000,

presenting 65 soil units evaluated according to the suitability degree for an intensive use - cultivation. Soil suitability map has multiple significance for various users. It is presumption for planning of a sustainable development and protection, as well as cultivation of soil. It serves as a base for different plannings in agriculture and forestry, for regional planning, protection

Table 4. Area of soil suitability classes

Suitability orders	Suitability classes	Main soil/land limitations	Area ha	%
S Suitable	S-1 Suitable	There are no important limitations and need for arrangement. Poor sensitivity against chemical pollutants.	313.875	6.6
	S-2 Moderately suitable	Moderate limitations due to inclination and/or erosion, debris-skeletal, drainage, rockiness. Medium sensitivity against chemical pollutants.	692.034	14.5
	S-3 Restricted suitable	Serious limitations due to inclination and/or erosion, soil depth, verticity, debris-skeletal, retention water capacity, acidity, rockiness and stoniness. Stronger sensitivity against chemical pollutants.	1.559.846	32.7
Total (S):			2.565.755	53,8
U Unsuitable	U-1 Temporarily unsuitable	Limitations which can be improved - acidity, excessive moistening, drainage, alkalinity, salinity. Different sensitivity against chemical pollutants.	688.027	14.4
	U-2 Permanently unsuitable	Meliorations are not possible and/or worth due to rockiness, stoniness, erosion, inclination, soil depth, acidity, verticity-texture. Different sensitivity against chemical pollutants.	1.518.143	31.8
Total (U):			2.206.170	46,2
(S) + (U)			4.771.925	100,0
Rocks			796.459	

of human environment, making of projects for main roads, gas pipelines, waterworks and other urban and industrial plants at regional and national level. It can also serve for education, military and even strategic purposes. Therefore, it is necessary to implement policy of a rational use and protection of soil - soil conservation. Protection of soil is not in competence of one sector or user only, but of all, including legislation and science. From a total of 47.719 km² of soils in Croatia there are 53,80% soils which different degree of suitability for an intensive use - cultivation. Only 14,4% of soils are temporarily unsuitable, while 31,8% are permanently unsuitable for use in primary plant - agricultural production.

REFERENCES

- Bartelli, L.J. et al. (1966): Soil surveys and land use planning, SSSA and ASA, Madison, Wisconsin
- Batjes, N.H., Bridges, E.M., ed. (1991): Mapping of Soil and Terrain Vulnerability of Special Chemical Compounds in Europe at Scale of 1:5 M. Proc. of an Int. Workshop held at Wageningen
- Bogunović, M., Racz, Z., Vidaček, Ž., Kaučić, D. (1995): Assessment of Erosion Risk and Land Quality in Southern Dalmatia. Objavljeno u Zborniku radova Međunarodnog simpozija održanog povodom 35-godišnjice Instituta za plodnost tla u Bratislavi, Slovačka
- FAO (1976): A Framework for land evaluation, Soils Bulletin 32, Rome
- FAO/UNESCO (1990): Soil map of the world, Revised Legend, World Soil Resources Report 60, Rome
- Oldeman, L.R. (1994): World Soils and Terrain Digital Database (SOTER). Past, present and future. Discussion note. ISRIC. Wageningen.
- Racz, Z. (1997): Pregled novijih istraživanja erozije tla u Mediteranu i mogućnosti njihove primjene u Hrvatskoj, Hrvatske vode god. 5, br. 20, Zagreb
- Škorić, A., Resulović, H., Vidaček, Ž., Martinović, J. (1984): Oštećenje zemljišta i potrebne mjere zaštite. Zemljište i biljka, 33(1), str. 1-6
- Várallyay, G., Szabó, J., Pásztor, L., Michéli, E. (1994): SOTER (Soil and Terrain Digital Database) 1:500.000 and Its Application in Hungary. Agrokémia é Talajtan, Tom. 43, No. 1-2, p. 87-108
- Vidaček, Ž. (1976): Prilog korištenju nekih klasifikacija tala zemljišta pri namjenskim pedološkim istraživanjima na primjeru dijela srednjeg toka rijeke Plitvice, magistarski rad, Zagreb
- Vidaček, Ž. (1981): Procjena proizvodnog prostora i prikladnosti tla za natapanje u Istočnoj Slavoniji i Baranji. Poljoprivredna znanstvena smotra br. 57(0), Zagreb
- Vidaček, Ž., Vančina, F. (1985): Karte upotrebne vrijednosti tala u funkciji prostornog planiranja i zaštite tla u Hrvatskoj. Zemljište i biljka, vol. 34, No. 3, 193-207, Beograd
- - - Ministarstvo poljoprivrede, šumarstva i vodoprivrede (1992): Pravilnik o zaštiti poljoprivrednog zemljišta od onečišćenja štetnim tvarima. Narodne novine br. 15, str. 274-276