SOIL EVALUATION

THE ROLE OF SOIL SCIENCE IN LAND EVALUATION

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LAND EVALUATION ?

OR

SOIL EVALUATION ?

land

soil

intrinsic properties: depth, texture, etc.

extrinsic properties: topography, climate, hydrology, vegetation and use.

socio-economic and political

workers,
machinery availability,
size and localization of parcels,
costs, investiment, market,
infrastructure, distribution network,
capital, official grants, agricultural policies,
etc.

Specialist invariably speak of land evaluation, while the term soil evaluation has today fallen into complete disuse.

Land evaluation

Highly detailed formulation

Requires multidisciplinary team

Partial developments

Confusing results

Dependence of demand (customers)

The definition of soil evaluation as an independent discipline avoids the disadvantages cite under Land Evaluation, fulfilling the following objectives:

To facilitate the study of soil evaluation by soil scientists.

To avoid the confusion that the current term “land evaluation” has generated.

To provide documents based on biophysical data much more stable than the aforementioned political, social and economic aspects.

To enable easy adaptation of evaluations according to situational changes.

To make soil evaluation a valid pursuit in and for itself, as an environmental resource, as important as knowledge of basic soil types, lithology, geology, hydrology, etc…

We propose the term **“soil evaluation”** for the assessment of soil properties as a phase prior to land evaluation. This involves understanding the soil properties in their broadest sense, including both the intrinsic ones (those of the soil itself—depth, texture, etc.) as well as extrinsic ones (of the soil surface—topography, climate, hydrology, vegetation and use.)

Land evaluation

Soil evaluation

intrinsic: depth, texture, etc.
extrinsic: topography, climate, hydrology, vegetation and use.

socio-economic and political

labour,
capacity level,
machinery availability,
size and localization of parcels,
costs, investiment, market,
infrastructure, distribution network,
capital, official grants, agricultural policies,
etc.

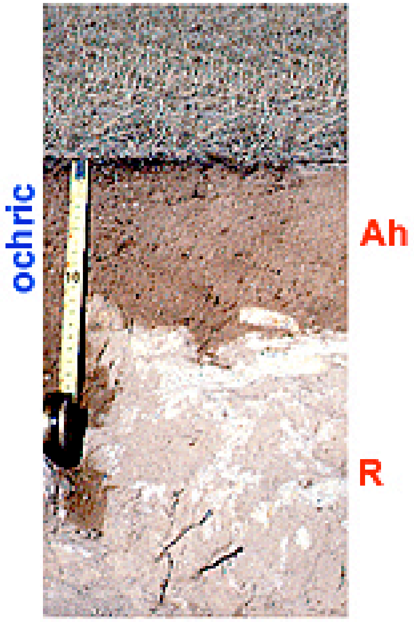
Soil evaluation + socio-economic and political evaluation = Land evaluation

Soil evaluation definition

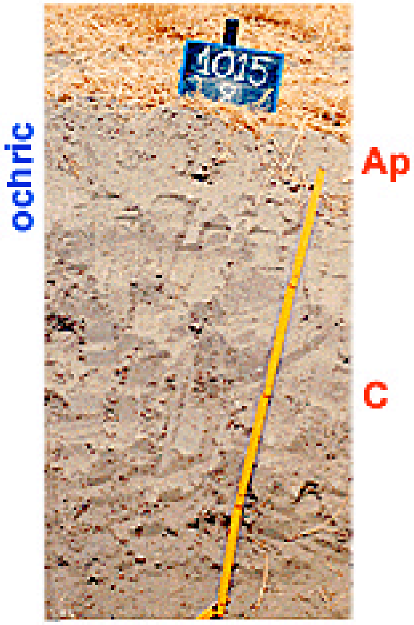
"any method to value or predict the use potential of soil"

Soil evaluation?

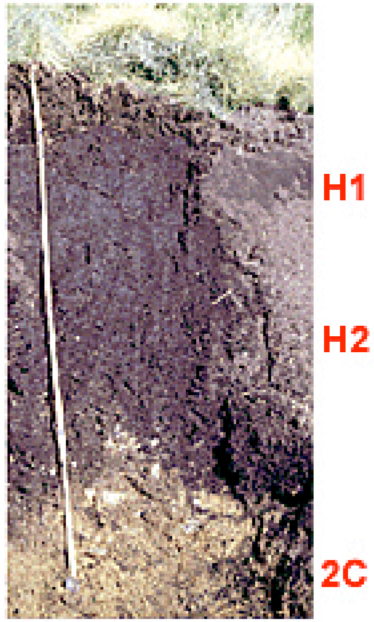
Why?



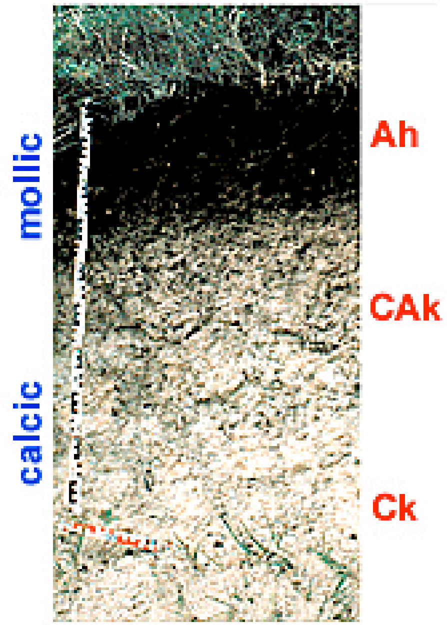
Dystric Leptosol



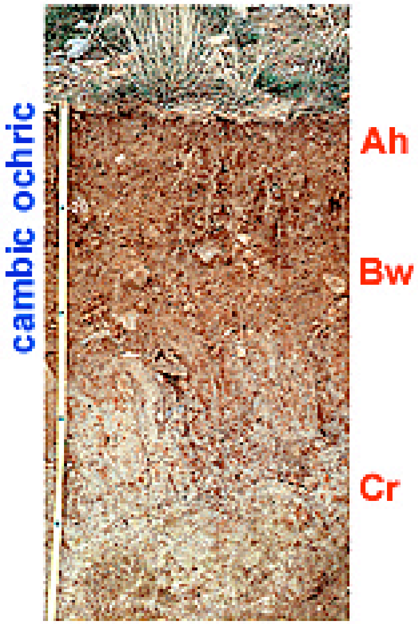
Calcaric Regosol



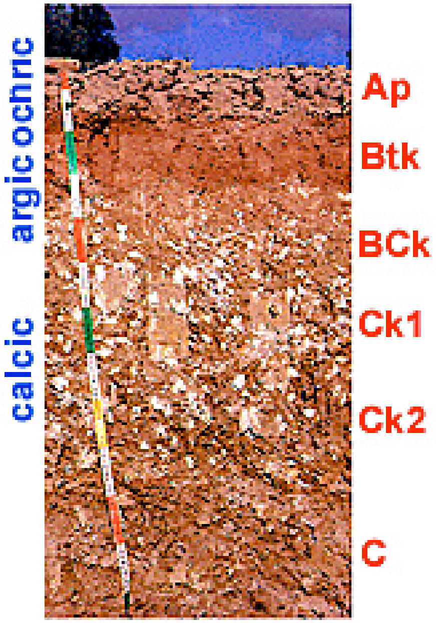
Terric Histosol



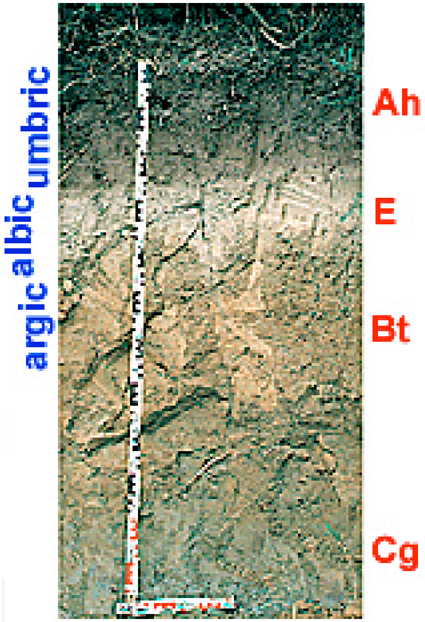
Calcic Chernozem



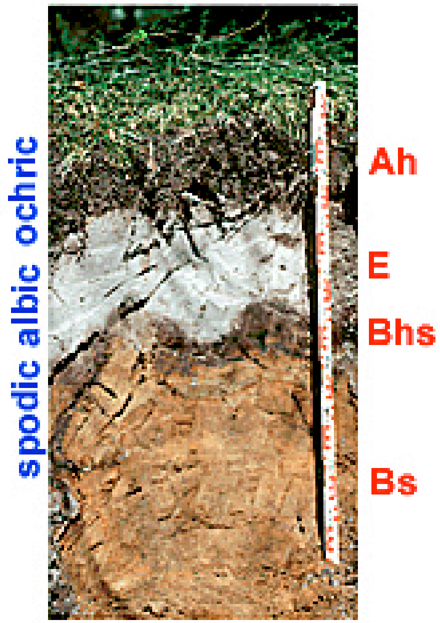
Gleyic Cambisol



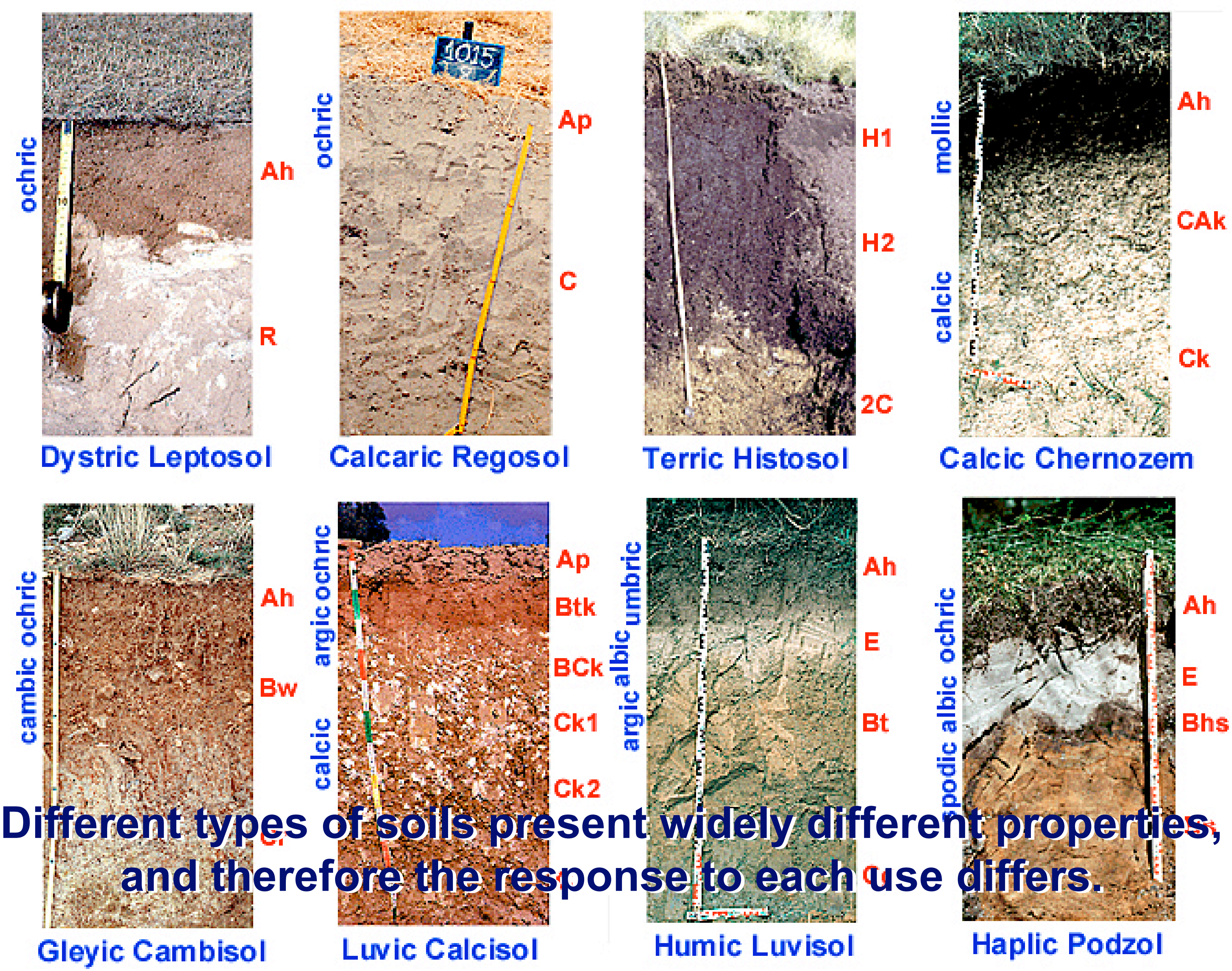
Luvic Calcisol



Humic Luvisol



Haplic Podzol



Different types of soils present widely different properties, and therefore the response to each use differs.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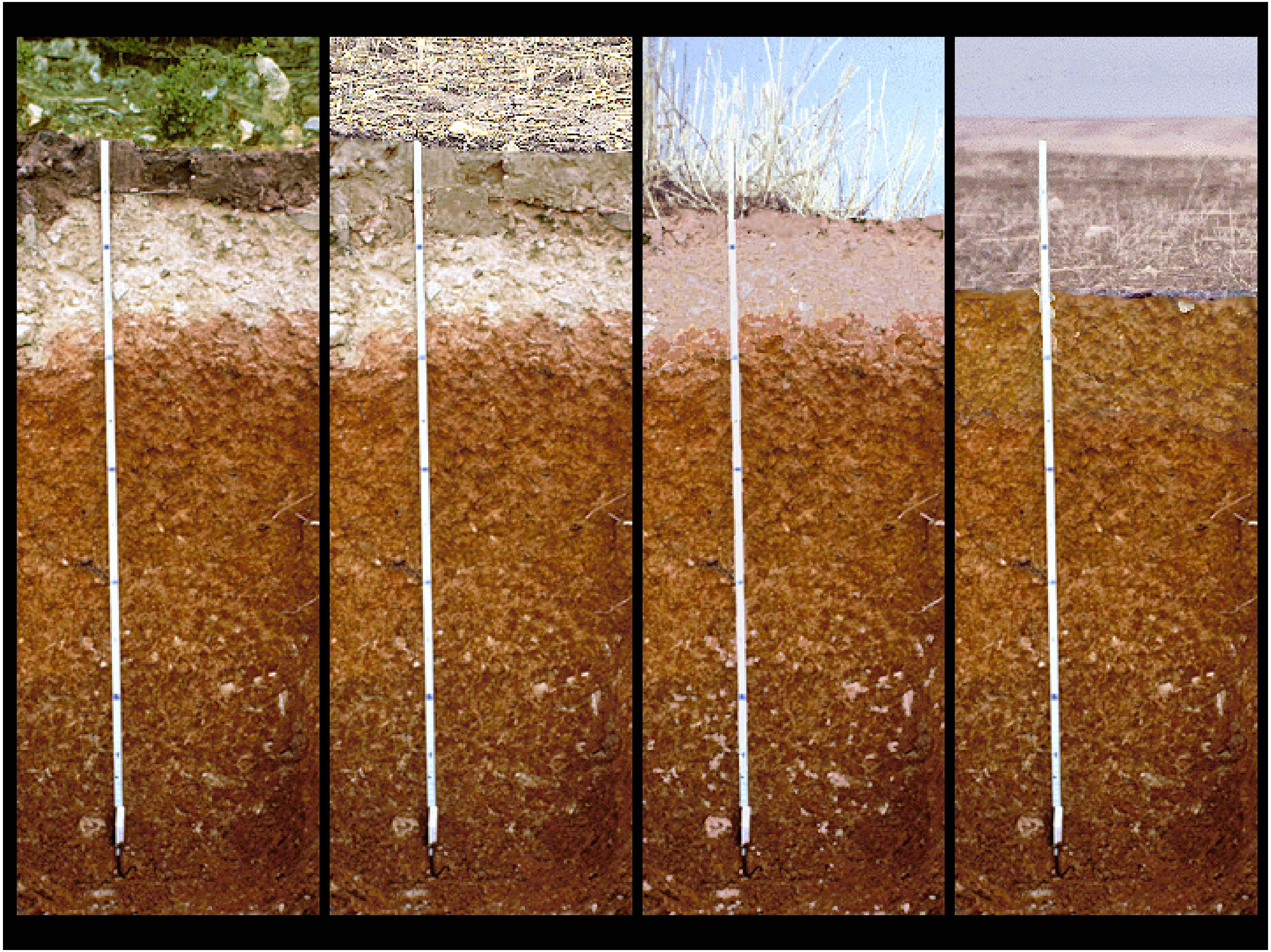

Basic ideas about soil evaluation:

1. Not all soils are equal.

Different types of soils present widely different properties, and therefore the response to each use differs.

Soil evaluation is based on the idea that the response for a determinate use is a function of their properties, and, hence, knowing these, we can predict the behaviour of the soil under a given use. From the study of such properties, different degrees of suitability of the soil can be inferred for each end proposed.

2. Use degrades soils.

The final aim of soil evaluation is an applied classification system that assesses the capacity of the soil for its optimal use—that is, **to derive maximum benefits with minimum degradation**.

When should soils be evaluated ?

Change in soil use of a parcel

Land-use planning

In commercial operations

In official operations

How should soils be evaluated?

Evaluation characteristics: soil properties with direct repercussion on yield, goods and services.

*** Effective soil depth**

1.- Very favourable	>120 cm
2.- Favourable	120-70
3.- Unfavourable	70- 30
4.- Very unfavourable	<30

*** Coarse fragments**

1.- Very favourable	>10 %
2.- Favourable	10-30
3.- Unfavourable	30- 360
4.- Very unfavourable	<60

Intrinsic properties

* Effective soil depth

1.- Very favourable	>120 cm
2.- Favourable	120-70
3.- Unfavourable	70- 30
4.- Very unfavourable	<30

* Coarse fragments

1.- Very favourable	>10 %
2.- Favourable	10-30
3.- Unfavourable	30- 360
4.- Very unfavourable	<60

* Texture

1.- Very favourable	balanced
2.- Favourable	moderate heavy
3.- Unfavourable	heavy
4.- Very unfavourable	light

* Structure

1.- Very favourable	fine/mediun, strong/moderate
2.- Favourable	coaerse, weak
3.- Unfavourable	single grains, structureless
4.- Very unfavourable	massive, structureless

* Available water

1.- Very favourable	> 100 mm
2.- Favourable	100-60
3.- Unfavourable	60-20
4.- Very unfavourable	<20

* Internal drainage

1.- Very favourable	Without hydromorphy
2.- Favourable	Hydromorphy > 80 cm
3.- Unfavourable	Hydromorphy > 40 cm.
4.- Very unfavourable	Hydromorphy = 0 cm

* Organic matter

1.- Very favourable	>5 %
2.- Favourable	5-2
3.- Unfavourable	2-1
4.- Very unfavourable	<1

* Cation-exchange capacity

1.- Very favourable	>40 $cmol_{(+)}kg^{-1}$
2.- Favourable	40-20
3.- Unfavourable	20-10
4.- Very unfavourable	<10

* Saturation degree

1.- Very favourable	>75% %
2.- Favourable	75-50
3.- Unfavourable	50-25
3.- Very unfavourable	<25

* pH

1.- Very favourable	7,3-6,7	
2.- Favourable	6,7-5,5	7,3-8,0
3.- Unfavourable	5,5-4,5	8,0-9,0
3.- Very unfavourable	<4,5	>9,0

* Carbonates

1.- Favourable	<7% de caliza activa
2.- Favourable	7-15
3.-Unfavourable	15-25
4.- Very unfavourable	> 25

* Salinity

1.- Very favourable	<2 dSm^{-1}
2.- Favourable	2-6
3.- Unfavourable	6-12
4.- Very unfavourable	>12

Extrinsic properties

* Slope

1.- Very favourable	<4 %
2.- Favourable	4-10
3.- Unfavourable	10-25
4.- Very unfavourable	>25

* Surface stoniness

1.- Very favourable	<2 %
2.- Favourable	2-20
3.- Unfavourable	20-50
4.- Very unfavourable	>50

* Surface rockiness

1.- Very favourable	<2 %
2.- Favourable	2-20
3.- Unfavourable	20-50
4.- Very unfavourable	>50

* Flooding

1.- Very favourable	0 months
2.- Favourable	<1
3.- Unfavourable	1-3
4.- Very unfavourable	>3

* Erosion

1.- Very favourable	<10 Tm/ha/year
2.- Favourable	10-20
3.- Unfavourable	20-60
4.- Very unfavourable	>60

* Ploughing

1.- Very favourable	no problems
2.- Favourable	limited
3.- Unfavourable	severe
4.- Very unfavourable	very severe

* Precipitation

1.- Very favourable	>1000 mm/year
2.- Favourable	100-600
3.- Unfavourable	600-300
4.- Very unfavourable	>300

* Frost

1.- Very favourable	<1 month
2.- Favourable	1-3
3.- Unfavourable	3-6
4.- Very unfavourable	>6

Evaluation systems

direct or indirect

degree of suitability or limiting factors

qualitative or quantitative

categorical or monocategorical

parametric or nonparametric

capability or suitability

agricultural ends or engineering uses

Evaluation systems

Are the methods of soil evaluation comparable?

Land Capability Classification (LCC), USA 1961

FAO Framework (FK), 1976

Storie Index (SI), 1935/1978

Riquier Productivity Index (RPI), 1970

using MicroLEIS software

(De la Rosa et al. 1992)

	LCC Land Capability Classification (SCS USA, 1961)	**SI** Storie Index (1935)	**RPI** Riquier Productivity Index(1970)	**FK** Framework for land evaluation FAO (1976)
Intensive soil cultivation (I)	I	1	P1	S1
Moderate soil cultivation (M)	II	2	P2	S2
Limited soil cultivation (L)	III	3	P3	S2
Occasional soil cultivation (O)	IV	4	P3	S3
Grazing (G)	V, VI	5	P4	N
Forestry (F)	VII	6	P5	N
Natural reserves (R)	VIII	6	P5	N

30 soils

Soil type	Parent material
1. Typic Cryosaprist	micaschist
2. Typic Xerofluvent	alluvial
3. Typic Xerofluvent	alluvial
4. Typic Xeropsamment	dolomite
5. Lithic Xerorthent	micaschist
6. Lithic Xerorthent	dolomite
7. Typic Chromoxeret	marl
8. Calcixerollic Xerochrept	marl
9. Calcixerollic Xerochrept	sandstone
10. Calcixerollic Xerochrept	conglomerate
11. Lithic Xerochrept	slate
12. Lithic Xerochrept	granite
13. Typic Humaquept	micaschist
14. Typic Cryumbrept	micaschist
15. Typic Haplumbert	micaschist

Soil type	Parent material
16. Vertic Haplargid	andesite
17. Petrogypsic Gypsiorthid	silts with gypsum
18. Lhitic Haploxeroll	conglomerate
19. Calcic Haploxeroll	micaschist
20. Typic Haploxeroll	sandstone
21. Typic Haploxeroll	micaschists
22. Udic Haplustoll	serpentine
23. Mollic Haploxeralf	limestone
24. Typic Haploxeralf	slate
25. Xerochreptic Haploxeralf	slate
26. Typic Rhodoxeralf	conglomerate
27. Calcic Rhodoxeralf	conglomerate
28. Mollic Palexeralf	limestone
29. Typic Palexerult	slate
30. Typic Palexerult	clays

Complete correspondence 9/30

Soil type	Parent material	LCC	SI	RPI	FK
2 Typic Xerofluvent	alluvial	M	M	M	M
3 Typic Xerofluvent	alluvial	I	I	I	I
5 Lithic Xerorthent	micaschist	Fs	Fdg	Fdg	Fs
8 Calcixerollic Xerochrept	marl	Od	Od	Od	Od
18 Lhitic Haploxeroll	conglomerate	Frd	Fd	Fdg	Fd
21 Typic Haploxeroll	micaschists	Fs	Fs	Fgf	Fs
22 Udic Haplustoll	serpentine	Ld	Ldt	Ld	L
23 Mollic Haploxeralf	limestone	Od	Od	Od	Od
26 Typic Rhodoxeralf	conglomerate	I	I	I	I

Capability class: I, intensice soil cultivation; M, moderate soil cultivation; L, limited soil cultivation; O, occasional soil cultivation; G, grazing; F, forestry; R, natural reserves.
Limiting characteristics: **e**, erosion; **d**, depth; **g**, gravels; **f**, frozen; **m**, moisture; **p**, permeability or drainage or flooding; **r,** rocks or pebbles or stones; **s**, slope; **t**, texture or structure.

Complete correspondence 9/30

The best equivalencies were presented when the maximum limiting factor was soil depth (d)

Soil type	Parent material	LCC	SI	RPI	FK
2 Typic Xerofluvent	alluvial	M	M	M	M
3 Typic Xerofluvent	alluvial	I	I	I	I
5 Lithic Xerorthent	micaschist	Fs	Fdg	Fdg	Fs
8 Calcixerollic Xerochrept	marl	Od	Od	Od	Od
18 Lhitic Haploxeroll	conglomerate	Frd	Fd	Fdg	Fd
21 Typic Haploxeroll	micaschists	Fs	Fs	Fgf	Fs
22 Udic Haplustoll	serpentine	Ld	Ldt	Ld	L
23 Mollic Haploxeralf	limestone	Od	Od	Od	Od
26 Typic Rhodoxeralf	conglomerate	I	I	I	I

Capability class: I, intensice soil cultivation; M, moderate soil cultivation; L, limited soil cultivation; O, occasional soil cultivation; G, grazing; F, forestry; R, natural reserves. Limiting characteristics: **e**, erosion; **d**, depth; **g**, gravels; **f**, frozen; **m**, moisture; **p**, permeability or drainage or flooding; **r,** rocks or pebbles or stones; **s**, slope; **t**, texture or structure.

Complete correspondence 9/30

The limiting factor slope (s) also gave coherent evaluations

Soil type	Parent material	LCC	SI	RPI	FK
2 Typic Xerofluvent	alluvial	M	M	M	M
3 Typic Xerofluvent	alluvial	I	I	I	I
5 Lithic Xerorthent	micaschist	Fs	Fdg	Fdg	Fs
8 Calcixerollic Xerochrept	marl	Od	Od	Od	Od
18 Lhitic Haploxeroll	conglomerate	Frd	Fd	Fdg	Fd
21 Typic Haploxeroll	micaschists	Fs	Fs	Fgf	Fs
22 Udic Haplustoll	serpentine	Ld	Ldt	Ld	L
23 Mollic Haploxeralf	limestone	Od	Od	Od	Od
26 Typic Rhodoxeralf	conglomerate	I	I	I	I

Capability class: I, intensice soil cultivation; M, moderate soil cultivation; L, limited soil cultivation; O, occasional soil cultivation; G, grazing; F, forestry; R, natural reserves.
Limiting characteristics: **e**, erosion; **d**, depth; **g**, gravels; **f**, frozen; **m**, moisture; **p**, permeability or drainage or flooding; **r,** rocks or pebbles or stones; **s**, slope; **t**, texture or structure.

Complete correspondence 9/30

Deviation of no more than one jump of class for each evaluation system: 13/30

Soil type	Parent material	LCC	SI	RPI	FK
6 Lithic Xerorthent	dolomite	Ggr	Gdgr	Gdg-->(P4)	Od-->(G)
7 Typic Chromoxeret	marl	M	Lp-->(M)	Mp	O-->(M)
10 Calcixerollic Xerochrept	conglomerate	L	Ld	M-->(L)	L
11 Lithic Xerochrept	slate	Ld-->(O)	Gdr-->(O)	Od	Od
12 Lithic Xerochrept	granite	Md	Ld-->(M)	Mdt	M
13 Typic Humaquept	micaschist	Gp	Gp	Fp-->(G)	Opf-->(G)
15 Typic Haplumbert	micaschist	Fs	Gsg-->(F)	Fgf	Fs
17 Petrogypsic Gypsiorthid	silts, gypsum	Odg	Gdg-->(O)	Gdg-->(O)	Od
24 Typic Haploxeralf	slate	Le	Le	M-->(L)	Le
27 Calcic Rhodoxeralf	conglomerate	Mg	I->(M)	I-->(M)	Mm
28 Mollic Palexeralf	limestone	Lr	Lt	Mt-->(L)	M
29 Typic Palexerult	slate	Ls	Lr	M-->(L)	M
30 Typic Palexerult	clays	Mes-->(L)	Lt	Lt	M

Capability class: I, intensice soil cultivation; M, moderate soil cultivation; L, limited soil cultivation; O, occasional soil cultivation; G, grazing; F, forestry; R, natural reserves.
Limiting characteristics: **e**, erosion; **d**, depth; **g**, gravels; **f**, frozen; **m**, moisture; **p**, permeability or drainage or flooding; **r**, rocks or pebbles or stones; **s**, slope; **t**, texture or structure.
In blue, the results that do not coincide with the evaluations of the other methods; in parenthesis the results that would correspond with the other methods.

Complete correspondence 9/30

Deviation of no more than one jump of class 13/30

Major divergences: 8/30 soils

Soil type	Parent material	LCC	SI	RPI	FK
1 Typic Cryosaprist	**micaschist**	**Osp**	**Ops**	***Ffp-->(O)***	**Osp**
4 Typic Xeropsamment	**dolomite**	**Fr**	***Lg-->(F)***	**Fg**	Or-->(F)
9 Calcixerollic Xerochrept	**sandstone**	**Gg**	Ogd-->(G)	Fg-->(G)	***M-->(G)***
14 Typic Cryumbrept	**micaschist**	Ls-->(O)	**Os**	***Ffg-->(O)***	**Osf**
16 Vertic Haplargid	**andesite**	**Gm**	***M-->(G)***	Fm-->(G)	**Gm**
19 Calcic Haploxeroll	**micaschist**	**Fs**	***Odg-->(F)***	***M-->(F)***	**Fs**
20 Typic Haploxeroll	**sandstone**	**Fs**	***Gsg-->(F)***	***M-->(F)***	**Fs**
25 Xerochreptic Haploxeralf	**slate**	**Ls**	**Lse**	***I-->(L)***	**Lse**

Capability class: **I**, intensice soil cultivation; **M**, moderate soil cultivation; **L**, limited soil cultivation; **O**, occasional soil cultivation; **G**, grazing; **F**, forestry; **R**, natural reserves.

Limiting characteristics: **e**, erosion; **d**, depth; **g**, gravels; **f**, frozen; **m**, moisture; **p**, permeability or drainage or flooding; **r**, rocks or pebbles or stones; **s**, slope; **t**, texture or structure.

In blue, the results that do not coincide with the evaluations of the other methods; **In red,** results that strongly differ from those of the other methods; **in parenthesis** the results that would correspond with the other methods.

Current trends and future perspectives

- The FAO Framework for land evaluation, despite the time which has passed since its appearance, continues to be the most widely used system. It can be applied to soil evaluation, and we believe that it can represent the standard soil-evaluation system.
- Comparable results, regardless of the method used
- Quantitative methods (data and results)
- Oriented towards suitability than towards capability
- Expressed in a simple manner
- Evaluations of each land unit to offer several prescriptions for use
- Dynamic evaluations as opposed to static ones in current methods
- Provide the degree of uncertainty in these studies
- Techniques of computerization and remote sensing
- Dynamic models for simulations
- Environmental and human-health issues:

sustainability versus production