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Critical review
Pregledni rad

SOIL INVESTIGATION IN GEOGRAPHY

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Abstract:

Article indicates methods for field investigation work on the area of soils, which in geography are very important for understanding the landscape. Special attention is given to this methods in geographic evaluation, especially in the last few years. Emphasis is on soil structure, with the help of pedology profile. Physical and chemical soil characteristics, measured in field and in laboratory, play an important role in land use possibilities.

Key words:

pedogeography, soil types, land use.

ISTRAŽIVANJE TALA U GEOGRAFIJI

Izvadak:

U članku se navode metode terenskoga rada u području istraživanja tala, u geografiji vrlo važna za razumijevanje krajolika. Ovim metodama se u poslijednje vrijeme posvečuje veća pozornost u geografskoj edukaciji. Naglasak je na spoznavanje strukture tala, uz pomoć pedoloških profila. Fizička i kemijska svojstva tla, mjerena na terenu i u laboratoriju, imaju važnu ulogu u procjeni mogućnosti načina korištenja zemljišta.

Ključne riječi:

pedogeografija, tipovi tla, korištenje zemljišta

1. INTRODUCTION

In the last few years we are noticing, that geographers are more and more interested in investigating soils. Already pupils in elementary and secondary school compete in knowledge about genesis, expansion and familiarity with soil characteristics. Students of geography, who are about to graduate, frequently decide their diploma paper to be from the area of pedogeography. In the existent elementary and secondary schools textbooks, we notice many inconsistencies with soil names. Mostly teachers, who should have enough professional knowledge about soils and their names, are lamenting over so many expressions, used in textbooks and atlases for naming soil types. Everyday experiences show, that graduate geographers as well do not know enough about soils, even though, these are a constituent part of landscape, and an important natural resource for every country. Such heterogeneous naming arises from the past, because people used various indications for soils; with regard to their predominating characteristics (sandy, clay-like), with regard to what kind of aggregates they originated on (limestone, sandbank-like), or with regard to their geographic expansion and vegetation (tundra soils, soils in steppe regions). However, new comprehension about soil characteristics in the last few years led to new classifications and naming of soils.

Intention of this article, accordingly, is to show the results of many years' research work on soils investigation, methodology and contents area.

Work methodology:

- survey of professional literature about soils names, and making a terminology dictionary for soil types,
- preparing work methods for field recognition of soils,
- making a manual for laboratory soil analysis in geography (including computer support),
- introducing some soil investigation results in geography.

2. NAMING OF SOILS AS BASIS FOR FIELD RECOGNITION

First cognition about soils were empirical, and at that time soils were named as wheaten soils, oaten soils, pasture soils, and suchlike. I was already in the past, when the first descriptions of soils by colour and structure appeared. Analytical knowledge about soils was wide, and that was the time, in which foundations of agricultural sciences were placed, but by Roman empire decay, knowledge about soils was regressing (Prus,1992).

It was most interesting, that individual sciences enforced many different soil names: botanists, wrote about pine, oak and prairie soils, geologists about granite, slate and limestone soils, climatologists about frozen tundra soils, tropical and moisture soils, and geographers about mountain, valley and coastal soils.

Not earlier than in the 19th century, Dokučajev set up foundations for classifying soils according to their genesis, and not just according to their characteristics. He defined them as an independent formation, separated from the basic rock. He explained their genesis by animate and inanimate organisms activity, basic rock, climate, relief and man activity. His ascertainments were used by Gračanin and Škorić, when designing soil names in Yugoslavia (Prus, 1992). Pedologists in Slovenia also designed soils classification, based on their origin, while geographers improved it for the landscape investigation needs.

2.1. Names of soils in the world and in Slovenia

Within the food and agriculture organisation framework (FAO), and education, science and culture organisation (UNESCO), a group of experts from various countries co-operated in a project, in which they designed a world pedology map. They made an international soils naming classification, for their purpose was, to uniform soil names of the whole world. The world soils map in map-scale 1:5 million, indicates 28 various soil types. Because the scale is small, it only indicates the most expanded soil groups on Earth. In 1988 scientists corrected and supplemented the legend of world soil groups in such a manner, that certain names for soil groups were united, and some new added. For that reason, the legend of soils around the world, does not match completely with the demonstration of soils expansion on the world map (Schultz,1995).

Naming of soils results from already established names of Russian, western European and American classification. However, scientists introduced some new names, and divided soil types according to physical and chemical characteristics into lower units. (Lovrenčak, 1994, p. 87)

The international soils classification system, used on the world soil map, is for a more detailed representation of soil expansion, a bit too rough. Consequently individual countries use national classifications, adjusted to regional conditions. Slovene classification is based on Yugoslavian, elaborated in 1985 by three authors: A. Škorić, M Čirić and G. Filipovski (Prus, 1992). Yugoslavian classification and names of soils were adjusted by Slovene pedologists to Slovene circumstances. They divided soils into four departments: (automorphic, hydromorphic, halomorphic and subaqualic). On pedology maps made after 1990, and in literature, pedologists use soil names from the new classification, with which they have completely substituted the old names (Stepančič, 1985).

Tab. 1: A simple matrix for identifying soil types. On the basis of horizons marked with X, the soil type is read (example for fig 1).

Tab. 1: Jednostavna matrica za identifikaciju tipova tla. Na osnovu opserviranih horizonata obilježenih slovom x, određuje se tip tla (primjer uz sl. 1.)

Horizons	Presence of horizon in soil profile	Notes
O – organic		
Ah – humus accumulative, rich on humus		
(A) – badly developed A		
A/C – transitional A and C		
A – humus accumulative	X	
E – eluvial		
(B) – cambic horizon		
Bfe – illuvia with iron accumulation		
Bg – illuvia with clay accumulation		
Bh – illuvia, with humus accumulation		
P – arable horizont		
Go – oxidant gley	X	
Gr – reductional gley	X	
T – peat horizont		
$CaCO_3$ – carbonate presence		
C – moulder basic rock		
R – bedrock		

3. IDENTIFYING SOIL TYPES IN THE FIELD

3.1. Key for identifying soils in the field

Identifying soil types out in the field is, for less experienced geographers quite often difficult, for which reason we have developed a simple key for identifying horizons in soils' profile. That key is used for identifying soils in Slovenia, where they are classified into two departments (automorphic and hydromorphic), and several classes, which combine like soil types. In the first column (table 1), are stated names of horizons with a short description, in the second there is space for marking noticed horizons, and the third column is there to inscribe observations.

Description of soil types in Slovene classification as help when in field recognising soils:

A) AUTOMORPHIC SOILS

I. UNDEVELOPED SOILS (A)-C
1. Litosol – stone rubble
2. Regosol – rough soil
3. Koluvial – deluvial

II. HUMUS AKUMULATIVE SOILS A-C
1. Rendzina
2. Ranker

III. CAMBIC A-(B)-C
1. Eutric - eutric cambisol – saturated with bases (% V) above 50 %, pH >5.5
2. Distric brown: distric cambisol, V<50 %, pH < 5.5
3. Brown pokarbonat - kalkokambisol
4. Red soil - terra rossa

IV. ELUVIAL ILUVIAL A-E-B-C, WASHED - debazification, acidification
1. Lessivaged, ilimerizirane, luvisol
2. Podzol. Affected by man E soils P-C

VI. ANTROPOGENE SOILS
3. Trench plough soil - rigosol
4. Garden soils - hortisol

V. TECHNOGENE SOILS I-II-III
1. Soils in depositions

Gleyed soil - hipogley

A
Go
Gr

Fig. 1: Soil type is gleyed soil – that is hipogley (foto: A.V. Korže, 1999)
Sl. 1: Tip tla je glejno tlo – hipoglej

B) HYDROMORPHIC SOILS

I. UNDEVELOPED HyDROMORPHIC (A)-C, (A)-G

1. River side soil – fluvisol

II. PSEUDOGLEYS A-EG-BG-C ALI A-BG-C

1. Pseudogley

III. GLEY SOILS (OGLEJENE) A-G

1. Swampy gleyed soils or gleys

IV. PEAT SOILS T-G

1. Peat soils of low swampland
2. Peat soils of high swampland

V. ANTROPOGENE HYDROMORPH P-G

1. Hydromeliorated

Halomorphic and subaqualic soils can not be found in Slovenia, for which reason we do not mention them specifically in soils description.

4. RECOGNIZING SOIL CHARACTERISTICS IN THE FIELD

Survey of materials, in which methods for investigating soils were published, or in any other way introduced, indicates, that the following methods can be used, for recognising soil characteristics:

- pedology profile description,
- horizon delimitation according to visible characteristics,
- measuring profile's depth and thickness of horizons,
- establishing mechanic composition with a finger test,
- measuring pH value,
- determining $CaCO_3$ with 10% HCl,
- structure description,
- moisture appraisement,
- colour description,
- determining consistency and
- organic substance estimation.

4.1. Soil characteristics observation and estimation

Soils can be estimated in many ways, not just with the help of an excavated pedology cave. Therefore, it is important for geographers to know the other possibilities of soil observation and estimation as well. These are:

- observing soils with the help of landscape relief, full of stir and movement (from relief configuration we inference on soil type and characteristics),
- estimating soils with the help of pedology map: the legend of the map tells a lot about individual soil types even before we go looking for them in landscape,
- estimating soils with ground sod (we dig up the upper soil layer with a spade, which serves for estimating basic soil characteristics),
- estimating and observing soils with the help of pedology profile: we dig it up with a spade or drill it with a pedology borer, from the surface to the basic rock. It enables an insight into soil's inwardness, its genesis and horizon structure,
- soil characteristics can be as well estimated with the help of vegetation, for it changes because of man's interventions. What we need therefore, is a map of real vegetation. Quite often advantageous soil characteristics coincide with areas used for agricultural purposes, while less advantageous soils are covered with forests. From forest type and expansion, we can conclude to prevailing soil characteristics (red pine prospers in acid soils, very permeable for water; black alder prospers in gleyic soils with more clay, black beech tree prospers only in warm positions on the developed rendzina soils). Whoever decides to estimate

soil characteristics, must therefore know, what are vegetation requirements for water, air, daylight, and mineral elements, namely because that are the most important factors of growth.

We can gather numerous information about soils and vegetation already by field observation, realising, that only observation may be subjective. For that reason, it is important to know objective methods, which help us measure soil and vegetation characteristics.

When measuring we distinguish:

- direct "manual" measuring (that is evaluating soils characteristics, and not a true measuring)

- measuring "in situ" with the help of various appliances, based on an direct measuring

- measuring characteristics based on soil samples taken in the field and brought to laboratory.

Some characteristics are evaluated descriptively, comparatively and semi-quantitatively (for example – we describe bigness of roots with big or small, according to average root length in horizons). Choosing measuring procedures for soil characteristics, we often take into consideration the following starting points:

- Do we need special knowledge from natural sciences, to carry out the methods?

- Do we need special knowledge about how to handle with appliances?

- We measure those characteristics which enable direct conclusions about processes in landscape.

Estimating soil characteristics in landscape is already fixed and standard procedure (characteristics can not be estimated our own way!).

4.1.1. Observation of soils with the help of relief surface configuration

A surveyable estimation of soils expansion may be performed on the basis of relief configuration. Relief stir is the result of basic rock and landscape development differences. Between relief configuration and soils exist the following connections:

- on very steep slopes the development of soils is slow, the result of that are shallow, skeletal soils (litosol, regosol);

- at the foothill of slopes gathers disintegrated material – such soils are deep (kolluvial soils);

- gently sloping hills enable the development of deeper soils (distric, eutric, rendzina, ranker);

- in plains and valleys soils are deep, if their genesis is not effected by water (eutric and distric). Shallow soils are those which originate by the rivers – river side soils;

- in relief depressions water height causes the development of gleyic soils;

- on terraces develop deep soils, with satisfactory physical and chemical characteristics, as well as washed out soils and

- in plains appear soils affected by man.

4.1.2. Estimating soils with the help of pedology map

Pedology map indicates on spatial expansion and type of soils. Better quality maps have in their legend ascribed basic characteristics about texture (which effects on many other characteristics). Information received from pedology map, is usually supplemented by field work. From the map scale it is evident what purposes it will be used for. Surveyable maps from 1 : 1 000 000 to 1 : 200 000 serve for basic orientation, but are not sufficient for soil estimation. However, maps like 1 : 25 000 or 1 : 10 000, and those of a larger scale, are basic for planning field work.

4.1.3. Estimating soils with the help of ground sod

Investigating soils with the help of ground sod is as important in praxis as it is for school use. In this case we do not analyse soil horizons, but only their upper part. When removing that upper layer we must care about roots, for which reason we lift the sod under the root layer. It is important that in cultivated fields we take away the upper layer deep enough, to reach under the cultivated horizon. The transition between cultivated and non cultivated layer is specially important for estimation.

On the ground sod bases we can answer the following questions:

- is in the entire upper layer soil soft or joined together?
- are roots normally grown?
- are soils airy enough, do they smell?

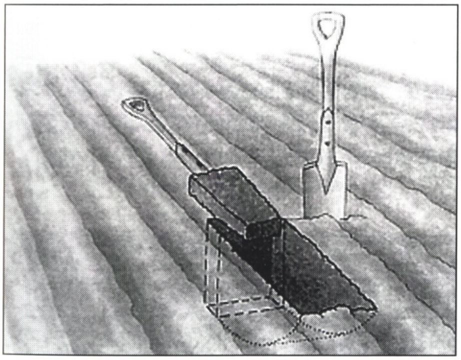

Fig. 2: Excavating technique of the upper soil layer (Elueckiger R., Rösch J., Stwrny W., Vökt, V., 1999).
Sl. 2: Tehnika iskopa gornjeg sloja tla

- are soils with or without structure?
- when brittle soil apart into lumpy like shapes, does it fall apart or stick to the hand?

4.1.4. Recognising soil with the help of pedology cave – soil profile

Pedology profile is also called a vertical soil section from the surface towards the basic rock. Out in the field we make a sketch of the excavated profile, add depth and horizon marks, and take away soil samples for laboratory analysis. When taking soil samples from the depth more than 20 cm, we use a pedology borer, or a spade to dig up a pedology cave. Up to 20 cm, we take soil samples with a spade from the ground sod. With borer we only get partial information about soil, for we get only partial insight into its inwardness. The choice of method, with which we excavate a profile or sod, depends on the aim of the work.

From the excavated profile we get information about:

- soil genesis,
- basic rock of the investigated area,
- thickness of horizons, which are the result of landscape genesis,
- taken samples can be tested out in the field with the help of a transportable laboratory, or can be taken to laboratory for further analysis.

5. METHODS FOR ASSESSMENT SOIL CHARACTERISTICS

5.1. Method for determining soil colour

Soil colour is an important morphological sign. It is basis for delimiting horizons in soil profile and for classifying soil types. Colour indicates processes which are going on in soil, and enables conclusion about chemical and mineral composition. It is effected by organic substance share, iron, manganese and mostly moisture.

5.2. Method for determining soil smell

Smell indicates on momentary oxygen supply in soil. An imperceptible smell indicates on good airing and big pores, filled with air. When processes in soil proceed without enough oxygen, the soil has a strong smell of silos.

5.3. Method for determining soil moisture

Dry soil when kneading in hands does not leave signs of moisture. Fresh leaves very soft, pale proof, moist leaves a well seen proof, and if it is wet, when pressing, the water comes out of it. Soil moisture depends

Fig. 3: Determining soil smell on the terrain (Elueckiger R., Rösch J., Stwrny W., Vökt, V., 1999).
Sl. 3: Na terenu se određuje miris tla.

on weather (evaporation, floods), and water closeness (underground water, surface water). It is crucial when deciding for time and cultivation technique. With machines we can cultivate soil to the depth so that it does not join together. If soil can be knead between fingers, it is too moist for cultivation. Out in the field we are ascertaining soils' moisture by pressing it in the palm, and observing the intensity of its proof on our hand.

5.4. Method for determining contain of skelet in soil

Skelet contain in soil can be established in many ways. By knowing the diameter of skelet pieces we establish bigness (we consider maximal bigness), on the basis of relationship between skelet and soil, we get volume share of skelet, and by observing roundness, we find out about shape. Out in the field when establishing bigness of skelet, we help ourselves by schemes.

5.5. Methods of determining soil texture

Soil texture is established on information about mechanic soil structure, that is on the basis of sand, clay and silt share. Pieces with diameter > 2 mm represent skelet, while those with diameter < 2 mm represent thin fraction.

Soil texture mostly effects on water share in soil, and land cultivation possibility. Silt soils are excessively wet and subjected to gleyic processes. Clay soils are also wet, unless they have an advantageous cloddy structure. Moist soils are often threatened by erosion and subjected to pressing. In the field we can ascertain the texture by observing soils' ability to form a ball shape, small tube shape and wrapping that tube around the finger.

Fig. 4: Determining texture with a finger test (Elueckiger R., Rösch J., Stwrny W., Vökt, V., 1999).
Sl. 4: Utvrđivanje teksture prstima

5.6. Method for establishing soil structure

Structure shows the way of connecting hard, liquid and clay pieces among themselves. It is effected by basic rock type, moisture degree, organic substance share, root quantity, soil development degree and way of land cultivation. Out in the field we observe, how pieces are connected to each other.

5.7. Method for establishing soils' permeability for water

Method is based on measuring water quantity, when soil has absorbed it, and on measuring time, which water needs to flow from the surface into the inwardness. This gives us numeric data about water quantity absorbed by sandy and clay soils, and tells us for how long water retains in soil.

5.8. Method for estimating root quantity in soil

Method is based on the ascertainment of average depth of roots in horizons. With soils rich with roots we determine the highest – that is the 6th level, while with soils, which are badly rooted, we determine the 1st level.

The other levels are: (very thick) – thick – middle thick – rare – individual – (no roots)

5.9. Method for measuring $CaCO_3$ in soil

Field method enables measurement in the range between 0.5 to 10% carbonate contain. We observe soil reaction by a diluted hydrochloric acid, which can be seen and heard. The method is not sensitive enough when $CaCO_3$ contain is above 10%.

5. 10. Methods for measuring soil reaction

Soil reaction is hydrogen ions concentration measuring. We measure it in electrometric way, or by an indicator. Soil reaction is the result of basic rock characteristics, recent pedogenetic processes, precipitation share and land use.

LABORATORY SOIL ANALYSIS

6.1. Types of physical and chemical soil analysis

In the last twenty years some methods have changed because of the appliances modernization, while some have appeared for the first time. Because soil is an important landscape component and because knowing it, is necessary for economic treatment, it is so important to know its basic characteristics. Geographers know the following physical soil analysis (for all analysis counted, we have results for Slovenia and partly for foreign countries):

- analysis of mechanic composition – grain pieces (% of sand, % of silt and % of clay)
- analysis of rough density and water quantity in soil sample - % of water
- analysis of pure density of sample – g/cm^3
- analysis of substance volume and pores (share of oxygen and water) in soil – %
- analysis of maximal water capacity in soil –V%, VV%

The chemical soil analysis are:

- analysis of organic substance share in soil with dry combustion - % of organic substance
- analysis of cation exchanging capacity (KIK), contain of hydrogen ions (H) and saturation of sorbitiv soil share with bases (V%)
- analysis of nitric compounds in water and soil (ammonia, nitrate, nitrite) –ppm

- analysis of phosphates in soil and water – ppm
- analysis of water hardness – hardness level

The majority of analysis, stated under field research can be done in laboratory, however, it is more recommendable, that some methods are done outside (colour, moisture, root quantity, and others).

6.2. Presenting results of field soil investigation

In this chapter we present some results of field and laboratory made soil analysis. In geography we devote a special attention to soils as a part of the landscape, for which reason research is usually bound to a specific region.

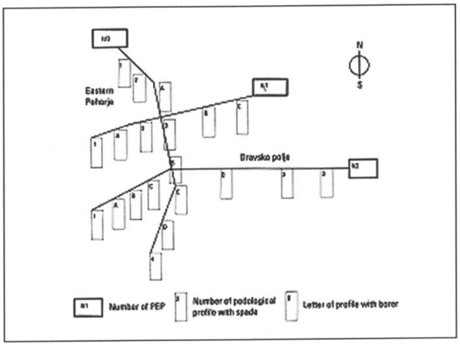

Fig. 5: The position of pedology soil profiles shows the spread of sample places (Vovk, A., 1995)
Sl. 5: Prikazom položaja pedoloških profila pokazujemo razmještaj mjesta uzorkovanja.

After determining spots meant for deprivation of soil samples, follows the individual

The date of the inventory:
The position of the selected region:
The surface of the investigated region:
The highest point:
The lowest point:
Base ground:
  Underground outflow: Q %
  Above ground outflow: R %
  Evaporation: PE %

Relief:	Sea level	Inclination °	Exposition
Climate:		Middle January amount of precipitation in mm Middle July temperature: °C Amount of precipitation in vegetation period in mm Middle temperature in vegetation period: °C	
Water balance :		Potential evapotranspiration: Precipitation difference: Water at the highest level: Water at the lowest level: Soil moisture index: Climate type:	

Soil types:
Vegetation formations:
Formations of fields use:

Fig. 6: Formulary for landscape inventory, in which pedology profile is placed
Sl. 6: Obrazac za inventarizaciju krajolika u kojem je uzet pedološki profil

profile inventory. Quite often we use in advance prepared inventory formularies.

The most important soil investigation procedure is field inventory of the dug up profile. We draw a simple soil profile sketch and use key for recognising horizons.

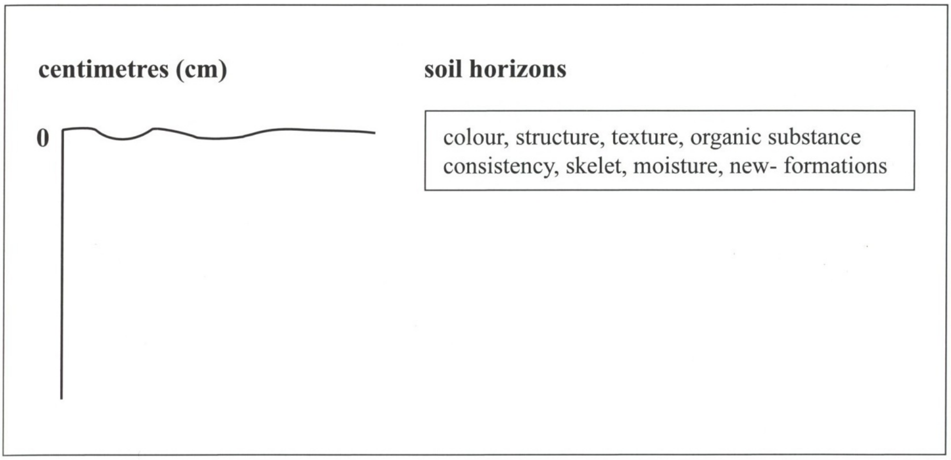

Fig. 7: Field inventory of the dug up profile.
Sl. 7: Uz svaki profil izrađuje se terenski zapis.

Soil characteristics – field observation

Structure (formation): non-structured, without structure, moulder like, lumpy like, nut shaped, polyhedron, prismatic, column like, leaf shaped.

Structure (size): thick, thin, very thin

Structure (manner): good, middle, bad, non-existent

Consistency: scattered, soft, brittle, compact, joined, solid, knead like, plastic, defiled, sticky

Consistency (manner): some, middle, very, hard

Organic substance: non-homogenous: (between structural aggregates, in the root tunnels)homogenous (organic, very strong humus, strong humus, humus, middle humus, bad humus, mineral

Rooting: very thick, thick, middle thick, rare, individual, non-rooted

Moisture: dry, dry/fresh, fresh, fresh /moist, moist, wet

New formations: concretions, spots, covers, clay, marmoreal, other (Fe, Mn, Ca)

Quantity; little, much, continual

Size: tiny, middle, thick

Tab. 2: Soil texture
Tab. 2: Tekstura tla

SOIL HORIZON	SAND % 2-0.02 mm	SILT % 0.02-0.002 mm	CLAY % < 0.002 mm
A	41,9	31,4	26,7
A/C	72,6	7,1	20,3
C	84,0	4,0	12,0

Tab. 3: The volume of substance, air and water in soil
Tab. 3: Volumen supstance, zraka i vode u tlu

SOIL HORIZON	substance volume %	air volume %	water volume %
A	52,0	22,0	26,0
A/C	57,8	27,2	15,0
C	62,7	28,3	9,0

Tab. 4: Other soil characteristics
Tab. 4: Ostale značajke tla

Soil horizon	depth cm	texture	Vkmax %	Kf cm/sec*10-3	V %	Sorption me/100 g			
						KIK	S	H	V%
A	0-20	IG	40,9	3,1	20,0	9,57	2,57	7,0	26,8
A/C	20-70	PGI	31,3	7,94	0,2	5,54	1,71	3,8	30,8
C	70-110	PI	30,3	4,94	5,1	1,97	0,27	1,7	15,2

Kf = Analysis of soils permeability for water
Vkmax = Analysis of maximal water capacity in soil
V% = Water countenance in soil sample

Tab. 5: A table example for the skelet share calculation in soil
Tab. 5: Primjer radne tablice za određivanje skeletnog udjela u tlu

PHYSICAL CHARACTERISTICS/ SKELET SHARE
Soil sample mark
The skelet share in soil
Mass of petry dish in g
Mass of petri dish in g+ mass of airy dry sample in g
Mass of shares >2 mm in g
Skelet share in %

In laboratory we perform additional soil research, which later serve for soil interpretation.

When calculating data about soils, we help ourselves with excell programmes, with which we calculate laboratory measured values.

Aim of geography soil research is to establish an integral analysis of region, respectively landscape. Knowledge about soils is needed for a permanent attitude towards nature. Fig. 8 shows the use of soil analysis results for determining biotops in region.

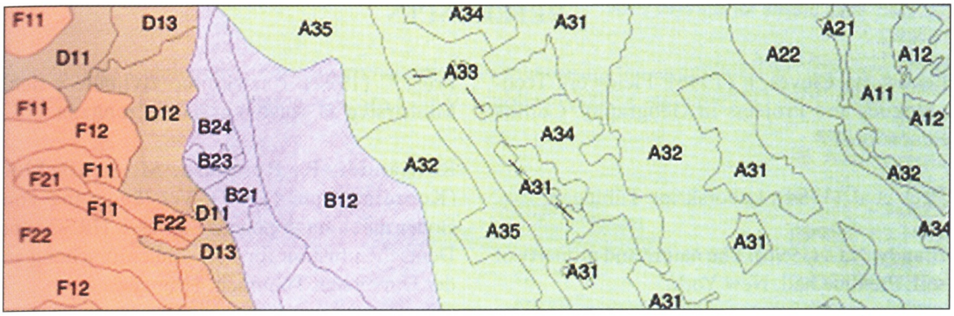

Fig 8: Connections between soil and land use (source: Vovk, A., 1998)
Sl. 8: Primjer povezanosti između tipova tla i načina korištenja zemljišta

The legend (example cases):
A32 – cultivated fields with small properties scattered on dystric ranker
B12 – cultivated fields on eutric brown
B21 – cultivated fields and meadows on eutric brown, pseudogleyic soil

CONCLUSION

Preparing instructions for various soil analysis in this manual, we have, up to some point considered the international standards, which became Slovene as well. It is important, that they are as much as possible used in geographic research, for this is the only way results of our analysis will be comparable to results of other investigators in our and foreign countries. We can not go beyond fact, that basis for understanding soils is to know their correct names. For that reason, when investigating soils an important stress should be on terminology. Developing early consciousness about responsible attitude towards country undoubtedly demands knowledge from the pedogeographic area. Experiences so far indicate remarkably positive results of introducing individual research work in this area. Methods for measuring soil characteristics are harmonized with international standards, which is important for comparing soil investigation results. Gladly we confirm the ascertainment, that pupils, and students know how to use methods for finding out physical and chemical soil characteristics. Much more effort will be needed with measured characteristics interpretation. Connecting data to landscape is necessary, and for making that easier we have developed a pedogeographic package, which leads the user step by step from field investigation across laboratory measures towards the interpretation of that data, and all that with connection to the landscape.

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Sažetak
ISTRAŽIVANJE TALA U GEOGRAFIJI
ANA VOVK KORŽE

S obzirom na izniman značaj poznavanja tla, kao jednog od elemenata prirodne osnove, pokazuje se potreba za jačanjem edukacije studentske populacije na području pedogeografije. Nije moguća potpuna interpretacija krajolika bez poznavanja tala, s obzirom da je tlo ne samo sastavnica krajolika, već i važan faktor u razvoju krajolika, osobito u načinu korištenja zemljišta. Primjećeno je da je u prošlosti korišteno više različitih klasifikacija tala, odnosno da je postojala heterogenost u imenovanju vrsta tala. U suvremenom istraživanju tala u geografiji potrebno je slijediti osnovnu nomenklaturu FAO-a i UNESCO-a, uz evenetualne manje prilagodbe na regionalnoj razini. Tako je u Sloveniji klasifikacija tala zasnovana na Jugoslavenskoj klasifikaciji iz 1985. (koja slijedi međunarodne norme), uz određene prilagodbe. Slovenske pedološke karte nakon 1990. godine sve slijede novu klasifikaciju s osnovnom podjelom na automorfna i hidromorfna tla (ostala dva glavna tipa, halomorfna i subakvatska nisu zastupljena u Sloveniji). Za kvalitetnu edukaciju geografa iz pedogeografije potrebna je odgovarajuća metodološka osnova. Bilo je potrebno izraditi detaljnje upute kako bi studenti geografije mogli uzorkovati i obaviti neka mjerenja na terenu te detaljne upute za laboratorijske analize (uključivši računalnu podršku) odabranih fizičkih i kemijskih svojstava tla bitnih u geografskim istraživanjima tala. Primjećeno je da studenti dobro obavljaju zadatke vezane uz prikupljanje i obradu podataka, a više je napora potrebno za interpretaciju podataka. Upravo je ključno povezati karakteristike tala s obilježjima krajolika, s obzirom da je jedan od glavnih ciljeva integralna analiza kako bi se utvrdio primjeren odnos prema prirodi odnosno krajoliku. U svrhu ostvarenja ovoga cilja pripravljen je i ovdje kratko prezentiran pedogeografski paket koji studenta vodi korak po korak, algoritamski, od terenskoga uzorkovanja i istraživanja, preko laboratorijske analize prema interpretaciji podataka u uskoj svezi s obilježjima krajolika.

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