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PREPARING A GEOREFERENCED SOIL DATABASE FOR ALBANIA AT SCALE 2:250,000 USING THE EUROPEAN SOIL BUREAU MANUAL OF PROCEDURES 1.1

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Introduction

The Interreg II Italy-Albania Project has a wide variety of components that try to bridge the two nations together. The project aims the overall development of the Republic of Albania and of the Region of Apulia. Funding is provided partially by the European Union and from the Italian Government. Among many issues developed under the Project, there was also a component that dealt with soil survey and soil mapping in both Apulia and Albania.

The Albanian share of the Project was divided in two parts:

Part 1: Development of a Georeferenced Soil Database of the complete territory (ca. 2.874.800 hectares) of the Republic of Albania at scale 1:250,000; and
Part 2: Development of a Georeferenced Soil Database for the coastal plains of the Republic of Albania at scale 1:50,000 (ca 250,000 ha of agricultural land)

The project included the soil survey of the whole territory of Albania and was finalised with the creation of a new soil map of the country at scale 1:250,000 (Map 2). Along with the preparation of the map, a georeferenced soil database was made possible. This enabled the creation of the Soil Information System of Albania, which is fully compatible with the European Soil Information System (EUSIS).

Following the objectives of Part 2, a much more detailed soil database was created for the western coastal plains of the country. An appropriate soil map at scale 1:50,000 accomplished this goal.

The most important aspect of this project however, is that for the first time Albania posses a soil database that was fully compiled according to modern European standards. Such databases are crucial for making environmental impact assessments and forecasting the trends of agricultural development. Part 2 in particular, has a strategic importance since deals with the most productive agricultural areas of the country.

Methodology

Methodology followed the document "Georeferenced Soil Database for Europe" Manual of Procedures - Version 1.1. - (doc. EUR 18092 EN) prepared by the Scientific Committee

of the European Soil Bureau (ESB) of the European Commission, otherwise known as the ESB Manual.

A step-by-step procedure included:

- Use of existing knowledge;
- Revision of the Soil Regions Map for Albania;
- First delineation of soilscapes with the aid of aerial photographs, and remote sensing images;
- Definition of the dominant soil for each soilscape;
- Exploratory soil survey and validation of the geometrical layers of the soilscapes;
- Database construction;
- Final mapping and preparation of the legend for the soil map; and
- Creation of the digital Albanian Soil Information System.

Results and Discussions

Revising of Soil Region for Albania

The existing Soil Regions Map of Europe at scale 1:5,000,000 enclosed in the ESB Manual shows just two soil regions for Albania. The reality of the territory of country however, is much more complex, therefore this map was revised thoroughly and a new one was prepared (Map 1). The criteria for delineating soil regions are given in Table 1.

Table 1: Summary of criteria and guidelines for the definition and delineation of soil regions

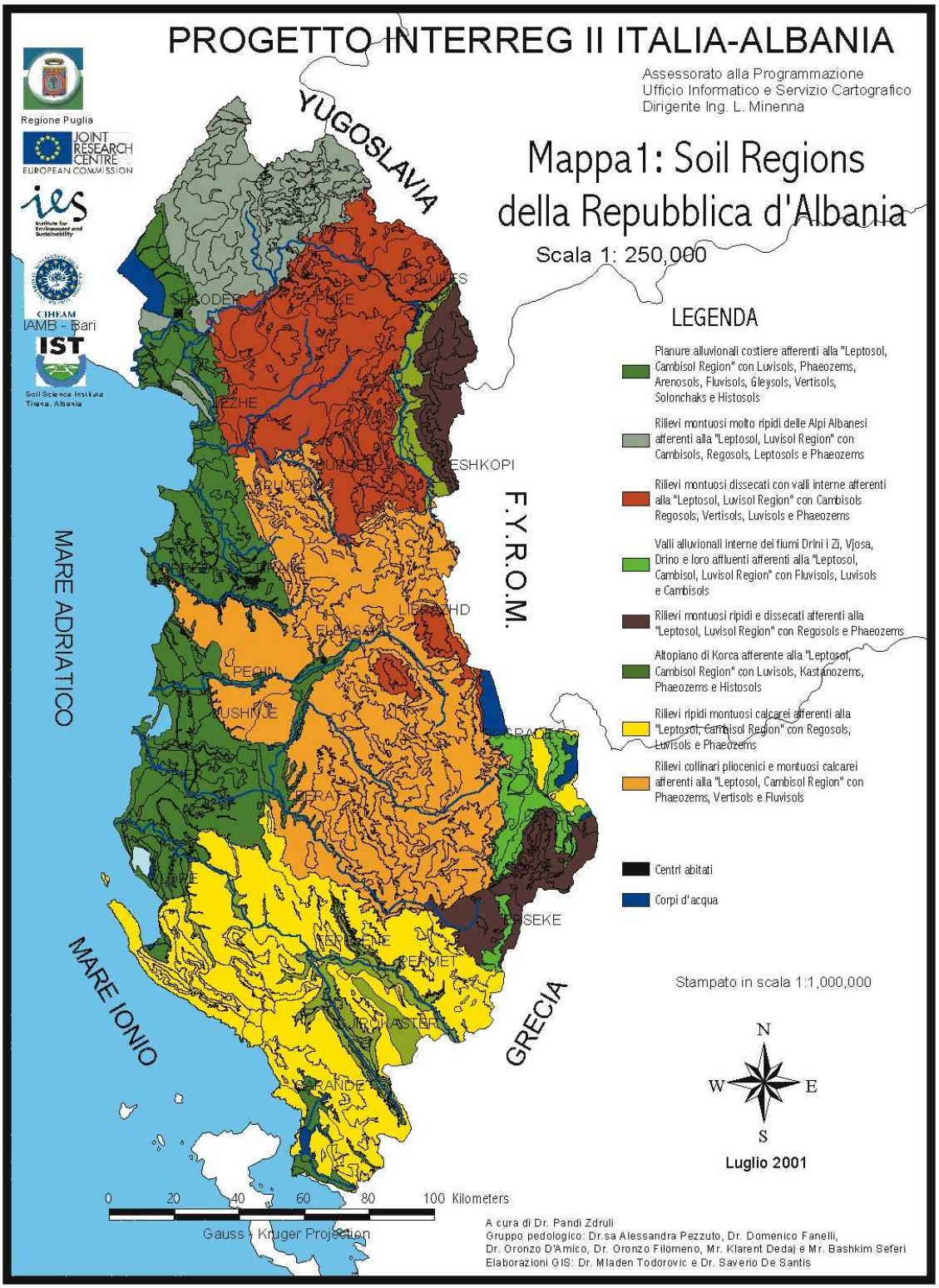
Object	Criteria		Guidelines	Delineation
	for definition	for delineation		
Soil region	1 Climate 2 Parent material association	1 Climate 2 Parent material association		concept added to the ESB Manual

First delineation of soilscapes

The digital GIS coverage available for the project derived from digitised local soil maps of all the districts of Albania. These maps were developed in the late 1980s according to the Albanian Soil Classification System (Zdruli 1997). These maps were revised and then converted to the World Reference Base for Soil Resources (WRB) system.

The procedure for delineating soilscapes is described in the ESB Manual. The methodology for soilscape delineation followed the "descending method" (Table 2). In order to make the best delineation of the polygons the following data sets were used:

- Topographic maps available at the archives of the Soil Science Institute (SSI) in Tirana, which covered both scales 1:200,000 and 1:50,000;
- Geological map of Albania at scale 1:200,000;
- Geomorphological map of Albania at scale 1:500,000;
- Forestry map of Albania at scale 1:200,000;
- Hydrological map of Albania at scale 1:200,000; and
- Soil map of Albania at scale 1:1,000,000 as well as other available sources of soil information.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Regione Puglia
JOINT RESEARCH CENTRE
EUROPEAN COMMISSION
CIHEAM
IAMB - Bari
IST
Soil Science Institute
Tirana, Albania
Mappa1: Soil Regions della Repubblica d'Albania
Scala 1: 250,000
YUGOSLAVIA
F.Y.R.O.M.
GRECIA
MARE ADRIATICO
MARE IONIO
LEGENDA
Pianure alluvionali costiere afferenti alla "Leptosol, Cambisol Region" con Luvisols, Phaeozems, Arenosols, Fluvisols, Gleysols, Vertisols, Solonchaks e Histosols
Rilievi montuosi molto ripidi delle Alpi Albanesi afferenti alla "Leptosol, Luvisol Region" con Cambisols, Regosols, Leptosols e Phaeozems
Rilievi montuosi dissecati con valli interne afferenti alla "Leptosol, Luvisol Region" con Cambisols Regosols, Vertisols, Luvisols e Phaeozems
Valli alluvionali interne dei fiumi Drini i Zi, Vjosa, Drino e loro affluenti afferenti alla "Leptosol, Cambisol, Luvisol Region" con Fluvisols, Luvisols e Cambisols
Rilievi montuosi ripidi e dissecati afferenti alla "Leptosol, Luvisol Region" con Regosols e Phaeozems
Altopiano di Korca afferente alla "Leptosol, Cambisol Region" con Luvisols, Kastanozems, Phaeozems e Histosols
Rilievi ripidi montuosi calcarei afferenti alla "Leptosol, Cambisol Region" con Regosols, Luvisols e Phaeozems
Rilievi collinari pliocenici e montuosi calcarei afferenti alla "Leptosol, Cambisol Region" con Phaeozems, Vertisols e Fluvisols
Centri abitati
Corpi d'acqua
Stampato in scala 1:1,000,000
N
W
E
S
Luglio 2001
0 20 40 60 80 100 Kilometers
Gauss - Kruger Projection
A cura di Dr. Pandi Zdruli
Gruppo pedologico: Dr.sa Alessandra Pezzuto, Dr. Domenico Fanelli, Dr. Oronzo D'Amico, Dr. Oronzo Filomeno, Mr. Klarent Dedaj e Mr. Bashkim Seferi
Elaborazioni GIS: Dr. Mladen Todorovic e Dr. Saverio De Santis

Table 2. Summary of criteria and guidelines for the definition and delineation of soilscapes

Object	Criteria		Guidelines	Delineation
	for definition	for delineation		
Soilscape	*Minimally:* characteristic association of physiography and parent material *Additionally*: geomorphology and texture	*Minimally:* physiography and parent material *Additionally:* geomorphology texture	1 Minimal size polygon: 1 km^2 2 Minimal distance on map of two arcs: 1 mm 3 Minimal size soilscape unit: 6 km^2 4 Soilscape= contiguous group of soil bodies	Using DTM, geologic and geomorphologic maps, land use maps, etc.

The original old GIS coverage contained a total of 902 polygons, however many of them were very small and less than 1,5 km^2, which is the minimum size delineating (MSD) unit according to the ESB Manual. Therefore they were merged with adjacent polygons after a careful investigation was made to decide which one polygon will adsorb the smallest ones. For Albanian conditions, however, the MSD was redused to 1 km^2.

The main criteria used for delineating the soilscapes at scale 1:250,000 (Map 2) were geomorphological characteristics, land use and vegetation. Especially natural vegetation in Albania has a strong correlation with elevation, and has been used as major criteria by the Albanian System of Soil Classification.

Typically, the flat areas of the western coastal plains are covered by *graminacea* type of vegetation, while the hills (up to 600 m) hold *machia mediterranea* vegetation. Moving towards the east of the country, the intermountain narrow valleys of alluvial and/or colluvial origin replace the ridge of hills paralleling the Adriatic and the Ionian coast. The high-eroded mountains at their footsteps have shrubs, followed by a sequence of oak, beech and pine forests at higher elevations. In many mountains, especially in the North Albanian Alps, at elevations above 2,000 m alpine meadows occur, which are used only for summer grazing.

Field soil survey and validation of the geometrical layers of the soilscapes

A team of Albanian and Italian soil scientists visited Albania during the months of March and May 2001 and sampled a total of 209 soil profiles. About 700 auger observations were collected through field surveys and existing soil data from the archives of the SSI. Part 1 included 100 profiles sampled throughout Albania and for Part 2 a total of 109 profiles were studied.

For the coastal plains survey, (Part 2) the guideline was to have 0.1 observations for each cm^2 of 1:50,000 soil map. The ratio between profile sampling and auger observation was about 1 to 0,7. No auger observations were made for Part 1. For all the sampled profiles (Part 1 and 2) about 900 soil samples were collected during the survey. Soil samples were analysed for standard analyses (EUR 18092 EN) at the Soil Laboratory of the SSI in Tirana.

All the studied soil profiles and auger observations were georeferenced using Geographic Positioning System (GPS) equipment. Consequently, the existing GIS coverage and the

geometry of soilscapes was checked and validated. Important changes were included in the final GIS polygon coverage of the map.

Photo 1. The valley of Shushica river, one of the major afluents of Vjosa river in Central Albania. On the foreground the deep alluvial/colluvial soils formed by fluvial and erosion activity. On the background the mountain of Lungara. As it could be seen the upper elevations are almost bare of vegetation

Definition of the dominant soil of the soilscape

Using the "ascending method" it was made possible to establish the dominant soil for each soilscape of the map. The criteria and guidelines for the definition of soil bodies within a soilscape are given in the ESB Manual (Table 3).

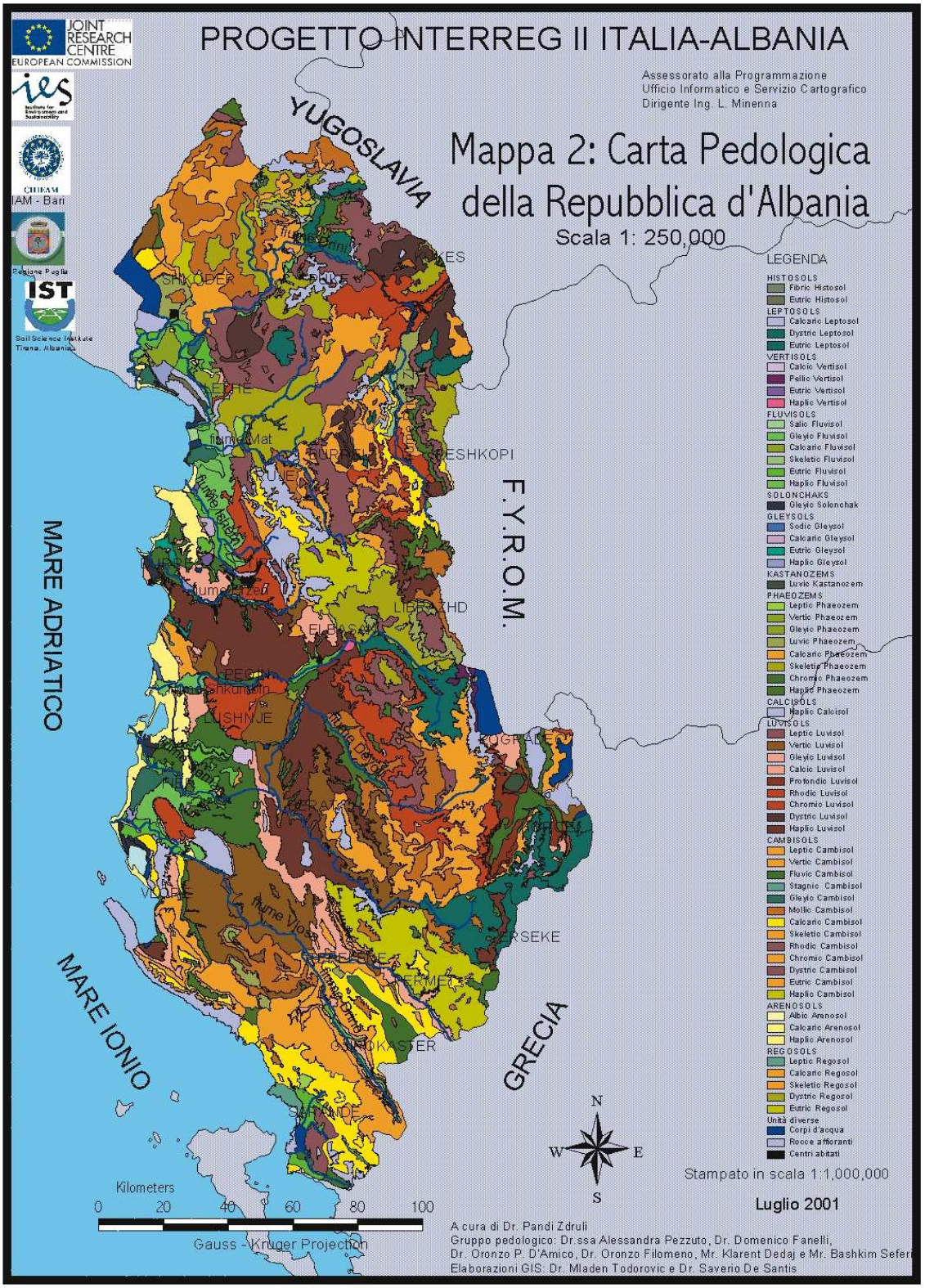
Table 3. Summary of criteria and guidelines for the definition of soil bodies

Object	Criteria		Guidelines	Delineation
	for definition	for delineation		
Soil Body	1 WRB-classification * 2 Parent material 3 Depth to obstacle for roots 4 Dominant texture and gravel content class 0-30 cm **	not applicable	1 One profile with estimated data in database 2 Two or more profiles with measured data in database 3 More than 90% of the area of a soilscape should be described by soil bodies ***	Only in small reference areas

* Reference soil group plus 2 qualifiers

** If an abrupt textural change occurs within the upper 30 cm, dominant texture and gravel content class refer to the layer(s) above the abrupt textural change

*** including similar soils. Similar soils are soils that show a minor variation in a soil property that induces a different classification.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Dirigente Ing. L. Minenna
Mappa 2: Carta Pedologica della Repubblica d'Albania
Scala 1: 250,000
YUGOSLAVIA
F.Y.R.O.M.
GRECIA
MARE ADRIATICO
MARE IONIO
LEGENDA
HISTOSOLS
Fibric Histosol
Eutric Histosol
LEPTOSOLS
Calcaric Leptosol
Dystric Leptosol
Eutric Leptosol
VERTISOLS
Calcic Vertisol
Pellic Vertisol
Eutric Vertisol
Haplic Vertisol
FLUVISOLS
Salic Fluvisol
Gleyic Fluvisol
Calcaric Fluvisol
Skeletic Fluvisol
Eutric Fluvisol
Haplic Fluvisol
SOLONCHAKS
Gleyic Solonchak
GLEYSOLS
Sodic Gleysol
Calcaric Gleysol
Eutric Gleysol
Haplic Gleysol
KASTANOZEMS
Luvic Kastanozem
PHAEOZEMS
Leptic Phaeozem
Vertic Phaeozem
Gleyic Phaeozem
Luvic Phaeozem
Calcaric Phaeozem
Skeletic Phaeozem
Chromic Phaeozem
Haplic Phaeozem
CALCISOLS
Haplic Calcisol
LUVISOLS
Leptic Luvisol
Vertic Luvisol
Gleyic Luvisol
Calcic Luvisol
Profondic Luvisol
Rhodic Luvisol
Chromic Luvisol
Dystric Luvisol
Haplic Luvisol
CAMBISOLS
Leptic Cambisol
Vertic Cambisol
Fluvic Cambisol
Stagnic Cambisol
Gleyic Cambisol
Mollic Cambisol
Calcaric Cambisol
Skeletic Cambisol
Rhodic Cambisol
Chromic Cambisol
Dystric Cambisol
Eutric Cambisol
Haplic Cambisol
ARENOSOLS
Albic Arenosol
Calcaric Arenosol
Haplic Arenosol
REGOSOLS
Leptic Regosol
Calcaric Regosol
Skeletic Regosol
Dystric Regosol
Eutric Regosol
Unità diverse
Corpi d'acqua
Rocce affioranti
Centri abitati
Kilometers
0 20 40 60 80 100
Gauss - Kruger Projection
N
W E
S
Stampato in scala 1:1,000,000
Luglio 2001
A cura di Dr. Pandi Zdruli
Gruppo pedologico: Dr.ssa Alessandra Pezzuto, Dr. Domenico Fanelli,
Dr. Oronzo P. D'Amico, Dr. Oronzo Filomeno, Mr. Klarent Dedaj e Mr. Bashkim Seferi
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The process of mapping and cartography is relatively easier for the sloping lands of the hills and mountains, but it is more complicated in the flat areas where neither geology nor the geomorphology or vegetation could provide all the changes in types of soils and their distribution. To achieve this, the flat lands were surveyed with much more priority and intensity.

To simplify this discussion an example could be used: the borderline between a Fluvic Cambisol and a Eutric Fluvisol was established relatively with a good degree of confidence. However, even for a map of 1:50,000 scale this is not an easy task to achieve. Moreover, the pedological landscapes of Albania as a Mediterranean country are very diverse and changes are observed rather frequently in short spatial distances.

A wide diversity of soils was discovered during the survey. The flat lands of the coastal plains are covered mainly with young soils of alluvial origin and typically silty nature. More typically they include Fluvic, Gleyic, and Calcaric Cambisols; Eutric and Gleyic Fluvisols; Calcaric and Haplic Arenosols; Haplic Calcisols; Luvic and Calcaric Phaeozems; Calcic, Vertic, Arenic, Chromic, Rhodic, and Haplic Luvisols; and Gleyic Solonchaks (see the Legend of Map 2).

Hills of the coastal area are mainly formed from sandstones, siltstones, and claystones (Geology of Albania, 1984). Many of them are calcareous; therefore the same characteristic is evident also on the hilly soils. Based on the field soil survey 60 *soil bodies* (SB) were identified for the whole country.

Conclusions

From this study could be reveled that land degradation is seriously damaging the natural resources of the country. Soil erosion is a major environmental problem. All kinds of soil erosion, including rill, sheet, and gully erosion are easily observable throughout the country.

Other forms of land degradation include deforestation, overgrazing, urbanisation, and chemical pollution near the old and abandoned mines as found in north Albania. Chemical pollution is a problem also in the oil fields.

Meantime the increase population trend continues to be high, putting therefore preasure on limited natural resources. The current population density is approximately 114 inhabitants per square km or 4.7 per ha of arable land. With its high population growth rate (which is the highest in Eastern and Southern Europe), it is expected that Albania will have 4.8 million people in 2025. Most of the population lives in rural areas (roughly 65 percent) and this makes difficult the rapid development of agriculture.

At present, there is tremendous pressure on the limited soil resources of the country. The fertile flat lands in the valleys are being “invaded” by the some time planned and often chaotic urbanisation, while deforestation, soil erosion and overgrazing are reducing the quantity and the quality of the sloping lands. Houses, businesses, and highways are being developed throughout the country, without considering carefully the quality of the land that is lost and the medium and long-term consequences of such actions are yet to be estimated.

The battle between industrial expansion, tourism, housing and agriculture was lost by the agriculture sector in many developed countries of Europe and especially of the Mediterranean region (*i.e.* Italy, Spain, Greece, and Turkey) and it is most likely that will be lost also in Albania.

The problem with Albania however, is that the agricultural land is finite and there are no left areas where there is space for expansion of cropland. Many mistakes were done in the past by converting natural pastures and forests to cropland and the negative results of such actions are well known in the country. (Zdruli, 1997a, 1998).

Salinity in the coastal are is on the rise and could strongly reduce the land available for crop production. The following picture was taken in Rremas, Lushnje (central coastal Albania) during the summer of 2001. The white mantel on the soil's surface is not snow but a thick layer of accumulated salt. It is estimated that about 15,000 hectares are affected by salinity in the country.

Photo 2. Typical Solonchaks of Rremas, Lushnje

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This project is the first one that involves both Albanian and Italian soil scientists to make pedological surveys in Albania. We are grateful to the support provided by the Albanian team. We can never forget the tens of Albanian farmers that very kindly helped us to dig and sample in their lands. Their generosity, hospitality and friendship is another important aspect of the soil survey experience and the human relationships that such a work can produce.

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