The status of soil survey in Albania and some of its major environmental findings

Zdruli P., Lushaj S.

in

Zdruli P. (ed.), Steduto P. (ed.), Lacirignola C. (ed.), Montanarella L. (ed.).
Soil resources of Southern and Eastern Mediterranean countries

Bari : CIHEAM
Options Méditerranéennes : Série B. Etudes et Recherches; n. 34

2001
pages 69-89

The Status of Soil Survey in Albania and some of its Major Environmental Findings

Pandi Zdruli[1] and Sherif Lushaj[2]

Introduction

Over the last thirty years, a valuable experience has been accumulated in Albania, regarding soil survey and its applications. Initially it was the Soil Science Department of the Agricultural University of Tirana who carried out soil activities, and then the Soil Science Institute (SSI) of Tirana, created in 1971 took the lead in all related activities. The latter is under the Ministry of Agriculture and Food and it is the only one in the country specialised in soil science.

Until the early 90s the Soil Science Institute, was very well organised, operating throughout the country, by carrying out pedological surveys and fertility tests all over the agricultural land of Albania. Other activities included drainage and irrigation research, soil microbiology, erosion control, and topographic survey. There were 26 districts at the time in the country, each of them having their own soil laboratory and a specialised staff, among them one pedologist and one soil chemist. The Institute provided only scientific and technical guidelines for the “district soil offices”, since their management was handled by local administration.

In twenty years period, detailed soil maps from 1: 10,000 to 1:50,000 scale, along with soil reports were prepared for each former agriculture co-

[1] CIHEAM-Mediterranean Agronomic Institute of Bari.
[2] Soil Science Institute, Instituti i Studimit të Tokave, Tirana, Albania.

operative, state farm and district. This indicates that soils have long been considered to be an important part of agricultural development. At national level is available a soil map at scale 1:200,000, which was compiled in 1958 Veshi and Spaho, (1988). The National Soil Classification System was adapted from the Russian System.

With the dawn of political changes and privatisation commencing at the beginning of this decade, the scientific institutions of the country went through drastic changes and setbacks. The Soil Science Institute in 1990 had a total staff of 194 people. Among them, 46 were scientists (11 having Ph.D.) and the remaining were laboratory technicians, field experiment labour force, drivers, supporting staff and administration. In 1999 the staff of the Institute shrunk to 15 scientists and 50 supporting staff. The district soil offices are non-existent anymore and very few soil analyses are being made in the country.

To overcome this situation an effort was made to rehabilitate the National Soil Laboratory at the SSI offices in Tirana. This was fully supported by a grant of the United States Agency for International Development (USAID) in 1998. At present this Laboratory is operational and makes soil, water, plant and fertiliser analyses for major required characteristics.

The most striking process that happened in the last decade in the Albanian agriculture was the change in land ownership. Until 1990, there were 550 agricultural co-operatives and state farms managing all the agricultural land (about 700,000 ha) of the country. Data from 1999 show that most of the agricultural land is distributed to about 500,000 farm families averaging less then 1,5 hectares per farm. This is the greatest "agrarian revolution" of the modern times in Albania regarding private land ownership. The process has gone (and is still going) through controversies on the way this privatisation is done, however, the will of the past Governments and of the existing one is to continue applying the existing law of land privatisation.

From the soils prospective the change in land ownership has brought to difficult times in keeping the link with the thousands of newly created farmers and SSI. Even though many farmers recognise the importance of soil fertility and conservation, there are no signs that anyone of them would consider paying for a soil survey investigation any time soon.

Therefore, even in the conditions of private farming, the opinion of the Ministry of Agriculture and Food (MAF) and of the SSI is that public funding or international donor funds should sponsor soil survey programmes. This becomes a priority especially in the pace of rapid increment of land degradation and environmental damage of Albania’s natural resources.

Accelerated soil erosion, deforestation, overgrazing, soil pollution, re-salinization, acidification, waterlogging, flooding, urbanisation, nutrient mining, and loss of soil fertility are perhaps the most alarming environmental problems in Albania (Zdruli 1994). There is an urgent need that these negative effects are being quantitatively estimated and steps are taken to reduce their effects. To achieve this, detailed soil maps and soil investigations are needed, supported by modern techniques like remote sensing and Geographic Information Systems (GIS).

Further soil surveys are planned in co-operation with the European Commission’s European Soil Bureau, the Region of Apulia in Italy and the Soil Science Institute of Tirana, under the Interreg II Italy-Albania Project. A mixed team of Italian and Albanian soil scientists will perform soil surveys both in Apulia and Albania.

The study foresees the surveying of all the coastal area and inland valleys of Albania at 1:50,000 and a new soil map of the country at 1:250,000. The latter will be completed following the European Soil Bureau Manual for the creation of a Georeferenced Soil Database for Europe (1998) and will be compatible with other soil maps and databases created throughout the continent.

Following this context, the Albanian delegation welcomes the idea of creating a network of soil information throughout the Mediterranean basin and offers all its commitment for making this network operational and successful. It is in this way that the contacts between the countries of the region will be strengthened for the purpose of making the area more productive and prosperous.

General Features of Albanian Pedological Landscapes

The Republic of Albania is located in the Balkan Peninsula, between 39^{o} 38' and 42^{o} 39' N latitude, and 19^{o} 16' and 21^{o} 40’ E longitude. The country has a total area of 28,748 square km, but only 16.2 percent are below 100m above sea level. It is a very mountainous country, with many varied landscapes, including bare rock. Agriculture is well distributed, but it is most intensive in the western coastal lowland. Albania has a total agricultural land area of about 700,000 hectares, which is about a quarter of total land area of the country. Because of the differences in climate, natural vegetation, elevation, slope, and parent rocks, soils are highly diverse (Zdruli 1997).

The National Soil Classification System

According to the National Soil Classification System the soils of Albania are divided into four belts, which constitute the zonal soils as shown below. The main criteria in their subdivision are elevation and natural vegetation.

Table 1 shows the Legend used to develop the first Soil Map of Albania at scale 1:200,000, which is presented at Map. 1.

Table 1. Generalised table of Albanian soils and their surface areas versus total agriculture land of the country

	Belts	Type	Explanation	%	Area[3] x 1.000 Ha
Zonal soils					
I	Subalpine pasture	LM	Mountain meadow	0.5	3.2
II	Beech and pine forest	MP	Dark mountain forest	3.0	20.2
		LMP	Dark meadow forest	0.6	3.4
III	Oak forest belt	KM	Cinnamon mountain	17.7	121.3
		KL	Cinnamon meadow	5.4	37.0
		LK	Meadow cinnamon	7.5	51.3
IV	Mediterranean shrubs	HK	Grey cinnamon	25.7	176.2
		HKL	Grey cinnamon meadow	6.4	50.7
		LHK	Meadow grey cinnamon	18.5	127.1
Azonal soils					
	Alluvial	AL	Fluviatile soils	11.8	80.9
	Peat	LT	Boggy soils	1.4	10.0
	Saline	LKr	Solonchak, solonetz	1.4	9.7
	Primitive mountain soils	PM	Undeveloped soils	0.1	0.4
	Sand beaches	PL	Undeveloped soils		0.2
TOTAL				100.0	691.6

Distribution of soils

I. Subalpine pasture belt at 1600-2700 m high.

[3] Area refers to total agricultural land of the country.

II. Beech and pine forest belt at 1000-1600 m high.

III. Oak forest belt at 600-1000 m high.

IV. Mediterranean shrubs belt at 0-600 m high.

The above belts show the distribution of soils that follow a sequential rule dominated by elevation and vegetation. These soils are called zonal soils. Their relevant characteristics are related to the fact that their formation occurred under specific biological, geological, topographic, and climatic conditions and their location is well defined according to the elevation. Soils within each belt do not occur in any other belts.

Map. 1 1958 SOIL MAP OF ALBANIA

INSTITUTI I STUDIMIT TE TOKAVE SOIL SCIENCE INSTITUTE TIRANA, ALBANIA	USDA/NATURAL RESOURCES CONSERVATION SERVICE WASHINGTON D.C., USA	INTERNATIONAL FERTILIZER DEVELOPMENT CENTER MUSCLE SHOALS ALABAMA, USA	U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT WASHINGTON D.C., USA

In areas where soil formation is not related merely to natural vegetation and elevation, soils are considered as azonal and include alluvial, peat, saline, and undeveloped or primitive soils. They can occur in all of the above mentioned soil belts.

The National Soil Classification System and methods of soil resource inventory, in Albania, were developed locally with minimal inputs from the outside world. Due to the size of the country and particularly, the extent of arable land, the Albanian system served its purpose by providing the first assessments for the land resources of the country and helped to make decisions on fertiliser use and land reclamation projects. However, modern concepts were not used and translation to other systems, such as Soil Taxonomy (Soil Survey Staff 1998) and the FAO Legend of the Soil Map of the World (FAO-UNESCO, 1988), proved cumbersome.

Classification of soils according to the US Soil Taxonomy

For a long time the Soil Science Institute and the Ministry of Agriculture has acknowledged the need for incorporating the country with international structures and institutions of soil science. However, although the need was appreciated, due to the general economic conditions prevailing in the country, no concerted effort was made.

During the period 1994-1997, the United States Department of Agriculture (USDA) Natural Resource Conservation Service) in collaboration with the International Fertilizer Development Center (IFDC) of Muscle Shoals, Alabama (USA), and the Soil Science Institute of Albania (SSI), undertook a project to document the soil resources of Albania. A joint team of Albanian and American soil scientists visited the country and sampled many sites. The earlier soil map the country prepared in 1958 and discussed at the above chapter was used as the base map.

At the end of this study a very detailed monograph was published (Zdruli, 1997), which compiled old and modern soil information into one source and provided the first soil map of Albania developed by international standards and methodologies. The map was prepared using the US system of soil classification otherwise known as Soil Taxonomy (Soil Survey Staff 1998) and is presented in Map 2.

Resource base assessments

The existing national soil map at 1:200,000 scale was first digitised using a PC ARC/INFO software, and then this coverage was used for the conversion process into Soil Taxonomy. Climatic information was also compiled and the soil moisture and soil temperature regimes (SMR and STR) were computed using a model developed by USDA/NRCS for each of the 208 climatic stations available in the country. The SMR and STR information is necessary for classifying the soils using the Soil Taxonomy system.

This preliminary information was then used for the field assessment of the soils. Thirty benchmark profiles were characterised and sampled for analyses at the NRCS laboratories in Lincoln, Nebraska. Hundreds of random observations using auger sampling or road-cuts were also made throughout the country. These were used to collect information on landform, land use and soil classification. The exact location of each observation point was determined using a Global Positioning System (GPS).

Map 2. SOIL RESOURCES OF ALBANIA

INSTITUTI I STUDIMIT TE TOKAVE SOIL SCIENCE INSTITUTE TIRANA, ALBANIA	USDA/NATURAL RESOURCES CONSERVATION SERVICE WASHINGTON D.C., USA	INTERNATIONAL FERTILIZER DEVELOPMENT CENTER MUSCLE SHOALS ALABAMA, USA	U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT WASHINGTON D.C., USA

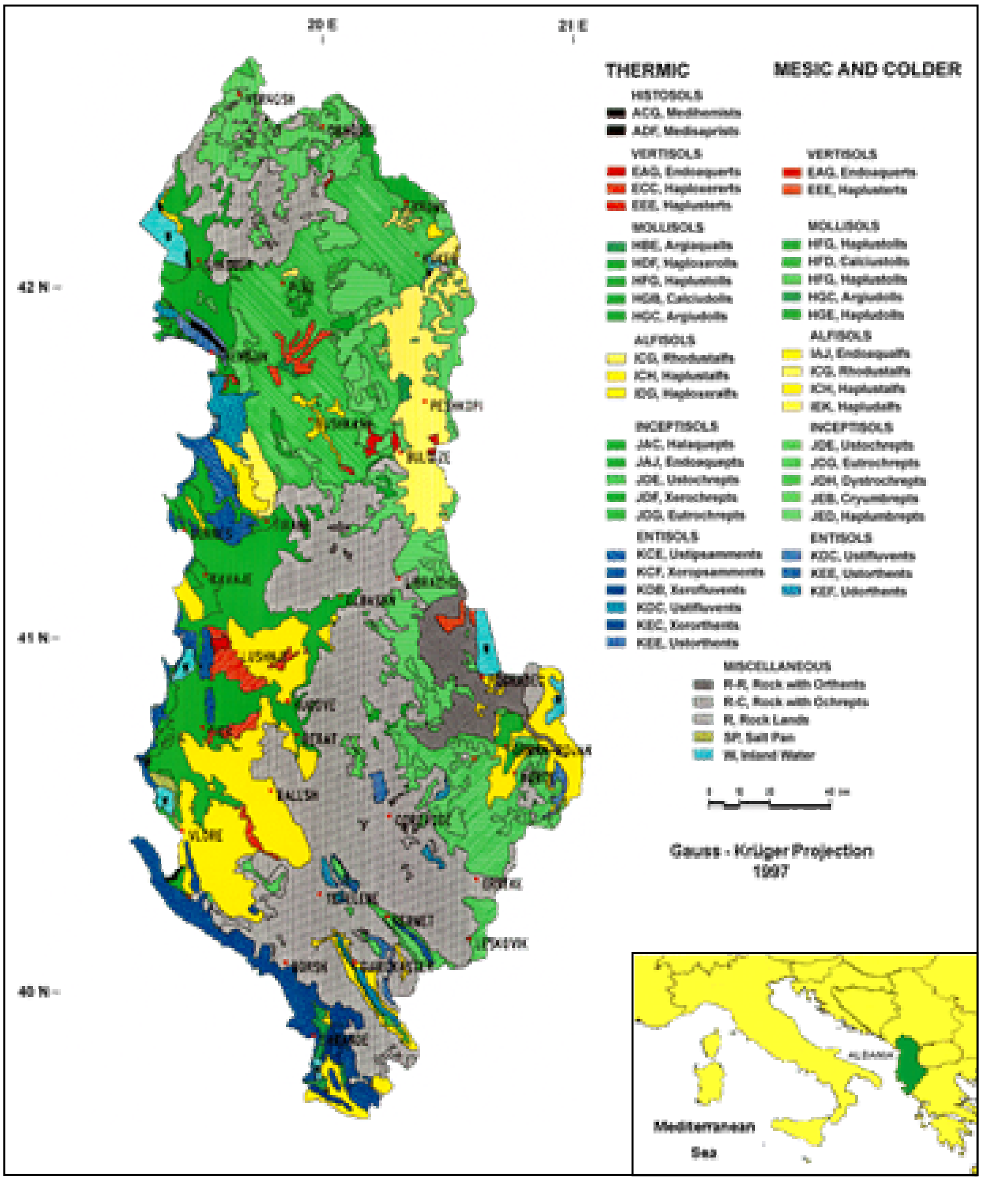

Table 2 shows the correlation between the Albanian systems of soil classification and Soil Taxonomy (Soil Survey Staff 1998).

Table 2. Albanian legend and Soil Taxonomy equivalents

Albanian Legend	Soil Taxonomy equivalents
Zonal soils	
Type *Description*	
LM Mountain meadow	Dystrocryepts
MP Dark mountain forest	Dystrocryepts, Eutrocryepts
LMP Dark meadow forest	Hapludolls, Haplustepts
KM Cinnamon mountain	Haplustepts, Haplustepts
	Haploxererts, Rhodustalfs Haplusterts
KL Cinnamon meadow,	Haplustalfs, Endoaqualfs, Haplustolls, Calciustolls
LK Meadow cinnamon	Hapludolls, Argiudolls
HK Gray cinnamon	Haploxeralfs, Haploxerepts, Rhodoxeralfs
HKL Gray cinnamon meadow	Haploxeralfs, Haploxerepts
	Calcixerolls
LHK Meadow gray cinnamon	Haploxererts, Halaquepts
	Argiaquolls
Azonal soils	
AL Alluvium soils	Ustifluvents, Xerofluvents Haplustepts, Haploxerepts Haplustolls, Haplustalfs
LT Boggy soils	Medihemists, Medisaprists Calciustolls, Endoaquerts
LKr Saline soils	Halaquepts
PM and PL Undeveloped soils	Udorthents, Xerorthents
	Ustorthents, Xeropsamments, Ustipsamments

Description of soil orders

The following is a brief overview of the soil Orders (Soil Survey Staff 1998) occurring in the country. For each Order, the range of properties, including land form and land use, is given. Six soil Orders are recognised in Albania: Histosols, Vertisols, Mollisols, Alfisols, Inceptisols, and Entisols. Table 3, which was generated using a Geographic Information System (GIS) lists the area extent in hectares for all soil at the great group level.

Table 3. Areas in hectares according to Soil Taxonomy Great Groups. (Soil Survey Staff 1996)

Soil Taxonomy classes	Total Ha	Soil Temperature Regime	
		Thermic	Mesic and colder
A HISTOSOLS	**3,978**	**3,978**	**-**
ACG Medihemists	3,037	3,037	-
ADF Medisaprists	941	941	-
E VERTISOLS	**58,542**	**37,756**	**20,786**
EAG Endoaquerts	6, 825	2,014	4,811
ECC Haploxererts	34,193	34,193	-
EEE Haplusterts	17,524	1,549	15,975
H MOLLISOLS	**208,402**	**154,894**	**53,508**
HBE Argiaquolls	7,284	7,284	-
HDF Haploxerolls	97,517	94,111	3,406
HFD Calciustolls	4,341	-	4,341
HFG Haplustolls	41,043	18,361	22,682
HGC Argiudolls	29,904	25,421	4,483
HGE Hapludolls	28,313	9,717	18,596
I ALFISOLS	**498,670**	**293,833**	**204,837**
IAJ Endoaqualfs	3,592	-	3,592
ICG Rhodustalfs	146,761	-	146,761
ICH Haplustalfs	90,491	37,557	52,934
IDG Haploxeralfs	256,276	256,276	-
IEK Hapludalfs	1,550	-	1,550
J INCEPTISOLS	**1,015,951**	**145,073**	**870,878**
JAC Halaquepts	11,261	11,261	-
JAJ Endoaquepts	33,348	33,348	-
JDE Ustochrepts	135,223	5,283	129,940
JDF Xerochrepts	95,181	95,181	-
JDG Eutrochrepts	320,767	-	320,767
JEB Cryumbrepts	121,559	-	121,559
JED Haplumbrepts	298,612	-	298,612
K ENTISOLS	**164,613**	**149,902**	**14,711**
KCE Ustipsamments	825	825	-
KCF Xeropsamments	15,843	15,843	-
KDB Xerofluvents	7,518	7,518	-
KDC Ustifluvents	30,902	26,635	4,267
KEC Xerorthents	89,900	89,900	-
KEE Ustorthents	11,774	9,181	2,593
KEF Udorthents	7,851	-	7,851
MISCELLANEOUS	**924,640**	**639,216**	**285,424**
R-C Rock with Ochrepts	726,838	613,747	113,091
R-R Rock with	99,219	-	99,219

Orthents			
R Rocky lands	52,991	-	52,991
SP Salt pan	4,056	4,056	-
W Inland water	41,536	21,413	20,123
TOTAL LAND & WATER AREA	2,874,796	1,424,652	1,450,146

Histosols

According to the Soil Resources map (Map 2), Histosols make up to 3,978 ha or 0.56 percent of the total agricultural land. The actual Histosol area has decreased compared with that of more than 40 years ago, since many of them were found to be Mollisols, Vertisols and/or Histosols. The difference appears to be because of the changes that have taken place in almost all the swampy areas of the country. After reclamation, these lands were put under intensive farming, which caused important changes in the properties of these soils. The most notable change was the reduction of organic carbon content.

Histosols in Albania are very productive soils. By using advanced technologies and high inputs, yields would probably double and the income could increase notably. The main tasks for the future remain the maintenance of the drainage systems and improvement of irrigation techniques.

Vertisols

Within the National Soil Classification System Vertisols were not identified as a separate type at the highest level and without regard to their typical physical properties, were included along with other types of soil in the same soil mapping unit. Recent studies, however, revealed that Vertisols are well present in Albania and occupy about 58,000 ha, or about 2 percent of the country's total area. The most extensive areas are found in low-lying terrain of the western coastal zone and have Thermic Soil Temperature Regime. All the magnesium-rich (smonitsa) soils having been formed on basic or ultrabasic rocks, or on their derivatives, classify as Vertisols, specifically as Usterts and Aquerts.

Vertisols are potentially good agricultural soils, but they need appropriate land management and especially excellent drainage system. Their major problems are related to physical soil characteristics such as plowing difficulties and water management. They offer considerable potential for the intensification of agriculture, subject to the application of technologies that are designed to meet the specific Vertisol management requirements.

Mollisols

Mollisols make up 7.25 percent or about 208,000 ha of the whole territory of the country. They are located both in thermic areas (154,894 ha) and mesic and colder temperature regimes (53,508 ha). Mollisols formed on strongly weathered alluvium from limestone, sandstone and shale formations, as in some areas of the coastal plains are very productive and fertile.

Generally, Mollisols are young soils. Radiocarbon dating shows that these soils can form in a period of 550 years to 1,000 years. This is sign of their “fragility” that can be altered by mismanagement. Intensive cultivation may lead to a drastic reduction of the organic matter content and lower their natural fertility.

Mollisols are very productive soil, where some of Albania's best yields in wheat, corn, sugar beet, potatoes, forage and vegetable crops are achieved. Investments in these areas are justified because a good return is guaranteed.

Other Mollisols classified within lithic or ruptic lithic subgroups are usually shallow soils equivalent to Rendzinas (FAO-UNESCO 1974), which are potentially suitable for forestry. Therefore, erosion control and reforestation should be the main focus for these areas in the future.

Alfisols

Alfisols cover approximately 498,670 ha or about 17.3 percent of the total land area of the country. They occupy the second largest area among the six orders of Soil Taxonomy found in Albania. The most essential pedological feature is the presence of the argillic horizon (Bt), which qualifies these soils as Alfisols. Almost 60 percent of them, which include Ustalfs and Xeralfs, occur in thermic areas. Other Alfisols are Aqualfs and Udalfs found only in mesic areas.

Typical Alfisols are the Rhodustalfs, which occupy areas from Kukës to Peshkopi in the north-east of the country and south towards Librazhd. They have a typical reddish colour very similar to the Mediterranean terra rosa, except they do not have a xeric SMR. The geology of the area where Rhodustalfs occur is made entirely of limestones.

Alfisols are well-developed soils and from the oldest ones identified in Albania. Data from Radiocarbon examinations show an age up to 8,500 years BP for an Alfisol sampled in the upper part of the valley of Korça, in south-eastern part of the country.

Alfisols have high potentials for agriculture. In particular the Haplustalfs of Korça are considered among the best soils of the country, especially for wheat, sugar beet and potato cultivation. Xeralfs are very good for olive groves, vineyards and fruit trees. A major constraint limiting higher yields is the dry season associated with the xeric and ustic SMR. Therefore, an adequate irrigation system is an important investment for the future.

Inceptisols

Inceptisols occupy the largest areas of the whole country. Their total surface area of 1,015,951 ha or 35.3 percent of Albania's territory, is divided into thermic, mesic and colder temperature regimes, but the major extent occurs in mesic zones. The main suborders according to Soil Taxonomy (1996) that had been identified are Aquepts, Ochrepts and Umbrepts.

Aquepts occupy entire areas in the northwest of the country. They are influenced by fresh alluvial depositions from the Drini and Buna rivers, which create the conditions for a aquic moisture regime. Other Aquepts are found in the western coastal plain at low depressions.

Saline areas are classified as Haplic or Vertic Halaquepts. It is important to emphasise that the area of these soils is increasing recently. Some other areas within the saline zone as in Akërni in Vlorë classify as Vertic Natraqualfs.

Xerochrepts are found only in the thermic areas, in the coastal plains, while Ustochrepts have a distribution in both thermic and mesic STRs. The Xerochrepts of the alluvial areas are very fertile, have a silty nature and good physical properties. Most Ustochrepts in mesic areas are relatively shallow, with a lithic contact within 50 cm of the soil's surface and are formed on ultrabasics rocks and limestones.

With such a large extent, Inceptisols have a great variety of potential uses and are found on some of the most fertile lands of the country. Endoaquepts, Xerochrepts and Ustochrepts of thermic areas in the flat zones can be used for intensive agricultural production, including cash crops under irrigation. Other Ustochrepts and Eutrochrepts occur mostly in mountainous areas and are best suited for forestry and grazing. Reforestation and grazing limits are necessary to control erosion in these areas.

Entisols

Entisols make up 5.7 percent of the total surface area of the country. They are spread throughout Albania, however they're major extension, occur in the thermic area. Only the suborders of Psamments, Fluvents and Orthents have been recognised.

Psamments are found only in thermic areas occupying the beaches of Adriatic and Ionian Seas. Fluvents occur in both thermic and mesic areas and are the equivalents of alluvial soils. They can have a xeric, ustic, or udic SMR. Orthents are located in thermic and mesic and colder STRs as well and cover much of rocky areas of the numerous mountains of

Albania. Wherever they occur, Orthents have a lithic contact within 50 cm or less and usually have little evidence of pedogenetic development. In the Albanian system of soil classification, they are equivalent to "primitive" or undeveloped soils.

Depending on their classification, Entisols in Albania have a variety of uses. Fluvents are very good soils, with high potentials for intensive farming. Their location is excellent for cotton, rice, corn and vegetable cultivation, but is dependent on irrigation capability. Orthents have limited potential for agriculture, but are naturally suited to forestry and grazing as long as erosion is controlled.

Miscellaneous soil units

The miscellaneous grouping includes a variety of soils, rock and inland water. This special category is introduced to better describe the Albanian landscape. Except for the Western coastal plain, the most visible feature of the country, is the presence of mountains and inland valleys. Generally at lower elevations within the inland valleys the soils are deep, fertile and suitable for agriculture.

Midslope soils are shallow with a lithic contact and are mostly covered by shrubs and forests. The highest elevations are mostly bare rock or a mixture of rock and some soil. It is this category that is represented under the miscellaneous groupings of Rock with Orthents, Rock with Ochrepts and Rock land. In the first two groupings, the ratio between soil and rock is about 1:4, while the last group is just bare rock. These subdivisions are found throughout Albania, mostly in mesic and colder areas. Together they make up to about 32 percent of the country's territory. That is quite a large area, which could be used for different purposes, including mining, forestry, and grazing or as protected natural areas.

Albanian Soil Data for the Soil Geographical Database of Europe at scale 1:1,000,000

The integration of Albanian soil information into the Soil Geographic Database of Europe was a timely event and for the first time included soil data for the country at the European level. This was done according to the Users Guide methodology that was developed for the elaboration of the European soil database version 3.1 (INRA, 1995).

Because the soils have been generalised from the original 1:200,000 scale soil map, it is impossible to show the full diversity of the soils at the scale 1:1,000,000. Included in this new soil map are 65 Soil Mapping Units (SMU), 57 presenting soil units and 8 of them non-soil SMUs (inland water). There are a total of 139 Soil Typological Units (STU), which are not shown individually on the map, but their details are included in the database. Twelve Major Soil Groups have been recognised at the first level of the FAO Legend (1974), and 25 soil types at Unit level.

The majority of Albanian soils are classified as Regosols, because much of the country is mountainous with shallow soils. Cambisols, Lithosols, and Luvisols are the next most important groups. A small area of Kastanozems has been identified in the north-eastern valleys as well.

Typical soils in the western coastal area are the Fluvisols, Luvisols, Phaeozems, and Vertisols. These are soils of alluvial origin of Quaternary deposits and are under the influence of Mediterranean climate. Bush and macchia mediterranea on the hills and grass type on the flat lands represent the natural vegetation. Arenosols occur on sand beaches and on the surrounding sand dune hills. Solonchaks are found in the low lying areas of the Adriatic Sea and pockets of Histosols occur in low depressions.

Included in the database for each SMU are twenty four attributes compiled in semantic tables showing major soil characteristics, like soil name according to FAO Legend of 1974 and the Revised Legend (FAO-Unesco, ISRIC 1990), dominant and secondary textural class, dominant limitation to agriculture use, parent material, maximum and minimum altitude, dominant and secondary land use, depth class to textural change, depth class of an obstacle to roots, impermeable layers within the soil profile, soil water regime, water management system in the agricultural land, and purpose and type of water management system. Since much of the information is based on expert judgement, a separate column indicates the confidence level of the Soil Typological Units attributes.

The database creates the possibilities for estimating other missing soil characteristics through the use of pedotransfer functions and rules (Bruand, et.al 1996). In this way, important information can be derived for the second and third level of the soil classification (FAO 1974, modified EC-ISSS 1985) and on the properties of parent material.

Along with the soil map, an analytical soil profile database was created for some representative soils of Albania. These data were entered in the database according to the guidelines described by Madsen and Jones (1995).

As soil patterns do not normally follow political borders, problems arose with the soil patterns in the border areas between Albania, Greece and Former Yugoslav Republics. These problems were resolved in collaboration with all of these countries.

The conclusions from the above study are summarised below:

- More detailed information at large scales of 1:10,000 to 1:50,000 is required to show the true picture of the soils in Albania;
- Agricultural land in the country is a finite resource and there is not much land left that is suitable for conversion to cropland;
- Sustainable land use has still to be developed;

- Land degradation is seriously threatening the soil resources;
- Extensive areas covered by shallow soils are best suited to forestry or managed grazing. At present, most of these are either mismanaged or have been abandoned, leading to accelerated soil erosion;
- The flat lands are intensively cultivated, but they are effectively under a nutrient mining regime because inputs do not match the outputs;
- Where management practices are inappropriate, waterlogging and re-salinization occur;
- Addressing these problems will require the adoption of a national soil policy, which takes into account sustainable land use practices and appropriate management strategies.

Land Resource Stresses and Environmental Degradation of the Natural Resources

Most of the internal resources and the energies of the Albanian people and the Government Institutions have been focused recently on making Albania a viable nation. Developing a democracy from a turbulent past is a difficult and slow process.

The time has come for the country to develop strategies and policies that address both production and environmental implications. Economic progress in the absence of environmental integrity is a formula for further discord between the natural ecosystem and the socio-economic indicators.

Description of land resource stresses

Degradation of natural resources deals with two interlocking complex systems: the natural system and the human-induced system. The interaction between the two systems determines the success or failure of resource management programs. Land degradation is increasingly threatening the quality of natural resources with direct impacts on sustainability of agriculture and eventually, the quality of life

(UNDP, 1995). The degradation processes in Albania include the human-induced land stresses like chemical pollution, salinization, nutrient mining of agricultural land, deforestation, over-grazing and accelerated soil erosion and natural processes or conditions, which include acidification, flooding, stony and shallows soils, and areas of low temperatures and poor accessibility.

The processes that are natural have a much lesser extent than the human-induced, which result from mismanagement and require both mitigating technology and also a societal commitment through stewardship and awareness. It is estimated that about 85 percent of the country's territory is under human-induced degradation stresses. Map 3 shows the spatial distribution of all the land resource stresses nationwide and Table 4 gives their respective surface areas.

Map 3. Land Resources Stresses

INSTITUTI I STUDIMIT TE TOKAVE SOIL SCIENCE INSTITUTE TIRANA, ALBANIA	USDA/NATURAL RESOURCES CONSERVATION SERVICE WASHINGTON D.C., USA	INTERNATIONAL FERTILIZER DEVELOPMENT CENTER MUSCLE SHOALS ALABAMA, USA	U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT WASHINGTON D.C., USA

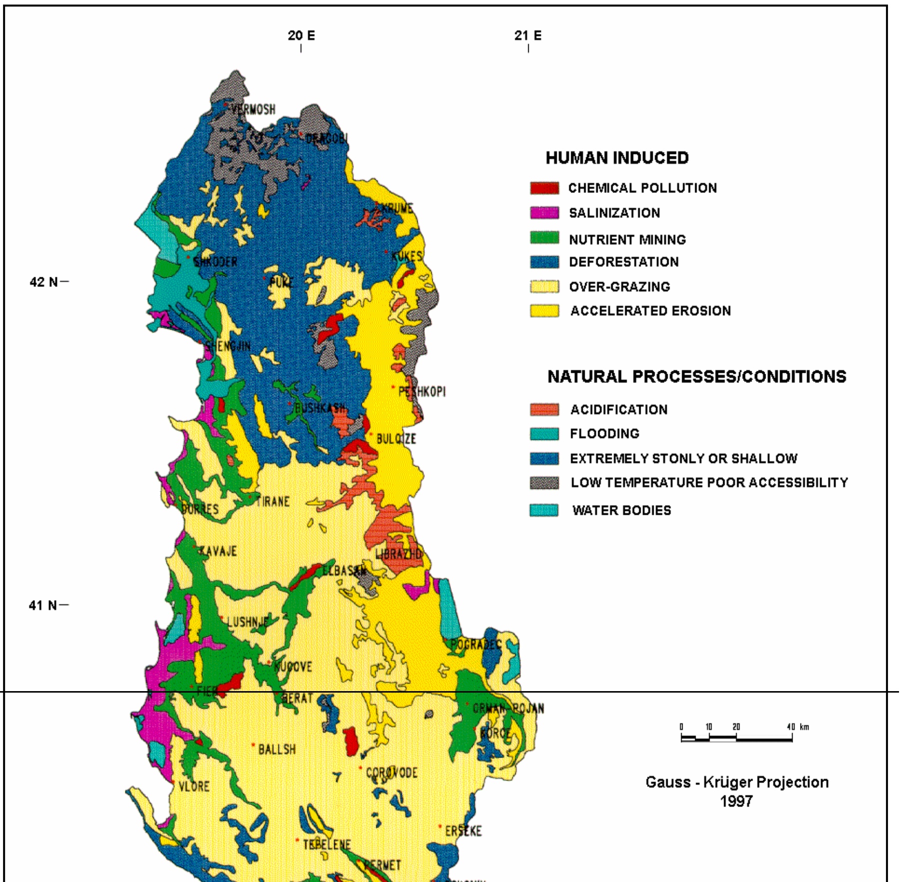

Table 4. Land Resource Stresses of Albania. Surface area in km^2 and in percent.

LAND RESOURCE STRESSES	Area	%
Human induced		
Chemical pollution	165	0.6
Salinization	654	2.3
Nutrient mining	2,936	10.2
Deforestation	5,005	17.4
Over-grazing	12,201	42.4
Accelerated erosion	3,585	12.5
Natural processes and conditions		
Acidification	624	2.0
Flooding	461	1.6
Extremely stony or shallow	1,614	5.6
Low temperatures/poor accessibility	1,182	4.1
Water	320	1.1
TOTAL	28,747	100

Soil erosion, deforestation and over-grazing are perhaps the most serious environmental problems in Albania today. Estimates for soil erosion show values from 32 tons per hectare up to 185 tons per hectare (The World Bank, 1993), however final scientific data are yet to be published. There are several factors contributing to accelerate soil erosion, which include natural ones (i.e. irregular rainfall pattern, shallow soils, high slopes, fragility of soil material) and human factors such as abandonment of sloping land, deforestation, over-grazing and misuse or mismanagement. Another form of degradation are the landslides, found in many areas throughout country, greatly reducing not only to the sustainability of agriculture but also the long term security of rural housing.

Eroded areas are spread all over, but most typically they occur in the northeastern part of Albania, where the degradation of natural resources is more intense (Zdruli 1998). The estimated area where erosion is the most constraining factor of sustainable development is about 350,000 ha.

A side effect of erosion is also the siltation of the reservoirs. There are more than 650 reservoirs spread all over the country used for irrigation and larger ones used for both power production and irrigation. At the existing rates of erosion and denudation of the sloping lands within the catchment area, life expectancy of the reservoirs will be greatly shortened.

Albania’s deforestation had started more than five hundred years ago, when most of the oak forests of the country’s southern part were cut to build the merchant ships of old Venice, and later because of the burning of wood for fuel, and the expansion of villages onto hillsides. The deforestation problem will particularly be intractable, unless some mechanism is found to increase alternative affordable heating and cooking supplies. Illegal cutting for commercial purposes had drastically increased over the last decade and the governmental structures are proving to be inefficient in halting the damage.

Recent data show an increasing number of livestock herds, which compete for food, therefore it is expected that the pressure on Albania’s pasturelands will increase. At the moment, ***overgrazing*** seems to be the most important factor affecting land degradation. Fires on natural pastures, such as in the southern part of the country, are causing considerable damages not only to pastures themselves, but also to forest, fruit trees, olives groves and biodiversity.

Both forest and pasture-lands make up 50 percent of the Albania’s natural resources, representing an extremely large area with high potentials for the development of the country, if managed properly.

Saline soils of Albania are located on the Western lowland coastal plain and are under the influence of Mediterranean climate, which accelerates evaporation in summer and causes salts to concentrate on the surface. The reverse phenomenon occurs in winter, when, because of heavy rainfalls, salts are leached down into deeper layers.

Typically salty soils occupy flat areas, often below sea level where saline conditions may also occur within the swamp and marsh soils. In recent years there is evidence of increasing salinization in those areas and unfortunately the trend is still continuing to be negative. Overall saline areas occupy about 30,000 hectares.

Flooding is increasingly becoming a problem especially in the northwestern part of the country. The same scenario is realistic for the many other lower part areas. Total estimated area under the threat of flooding is more than 40,000 ha of land. There is a chain reaction from overgrazing, deforestation and erosion culminating in the flooding, which is also accelerated by the poor maintenance of drainage canals and pumping stations. Waterlogging is reducing yields in those areas and the reverse phenomena of swamp and marsh formation is becoming evident.

Acid soils are mainly located in the north-eastern part of Albania and to a limited extent in the south-east. Acidity plays an important role in reducing crop yields. Since acidification is a natural process influenced by the parent materials and the climate of the area, there is concern that the acid soils may expand, even in those lands that were considered ameliorated by using lime a few years ago. The estimated area of acid soils is about 60,000 ha, but that may reach values as high as 90,000 ha, according to some surveys of the Soil Science Institute.

Albania has a relatively short history in fertiliser use and very long tradition in agriculture that dates back more than 2,000 years. Soils have been exploited systematically and have received little inputs from other sources, other than some manure. Even during peak years, the country had used fertilisers less than almost any other nation in Eastern Europe. Still the rates of fertiliser use are far below the needs, mainly because of low purchasing capacity. It is believed that most of the best agricultural lands in the country today are under ***nutrient mining*** conditions leading to a continuous reduction of soil fertility. Overall affected area is about 200,000 ha located in the flat zones.

Site-specific stresses

Certain areas within the country are affected by several kinds of typical stresses. They can be summarised as: urbanisation of high quality farmland, point-source contamination from mining activities, factory wastes and effluents, uncontrolled and random disposal of urban waste on agricultural land, heavy metal contamination from natural and human activities, and loss of biodiversity.

There are no available data on the surface areas effected by each of the site-specific elements. Some estimates (UNDP 1995) for the urbanisation of the surrounding areas of the capital city of Tirana show that the land lost to unplanned construction is one and a half times larger for the same number of inhabitants, than if the home-construction would have been planned. Agriculture land contaminated by the oil and gas industry, factory wastes and effluents is roughly 50,000 ha.

Albania has the highest population growth rate in Europe. In less than 50 years its population has tripled, and this trend is expected to continue, at least over the medium term. This is the main reason why the food policy for the country must promote the sustainable management of soil resources in harmony with the environment.

The present picture is not very promising, since much of the land is mismanaged. Sloping lands are either abandoned or under the increasing threat of erosion and overgrazing. Flat lands are being explored continuously without little inputs added to the soil, however, the biggest threat is the alarming urbanisation by home construction, building highways and business, which are invading enormous areas of very fertile land. Those lands are the most productive in the country from the agricultural prospective. They should be protected for the next generations.

References

Bruand A, O. Duval, H. Wosten, and A. Lilly. 1996. The use of pedotransfer in soil hydrology research in Europe. Workshop proceedings. Orleans, France, 10-12 October 1996. Office for Official Publications of the European Communities, Luxembourg. 211pp.

European Soil Bureau, Scientific Committee. 1998. Georeferenced Soil Database for Europe, Manual of Procedures, Version 1.0. 170 pp.

EC-ISSS. 1985. Soil Map of Middle Europe 1:1,000,000 Explanatory Text.

FAO-UNESCO. 1974. Soil Map of the World, 1:5,000,000. 10 Volumes. Publication of the Food and Agriculture Organisation of the United Nations, Rome, Italy.

FAO-UNESCO. ISRIC. 1990. FAO-Unesco Soil Map of the World: Revised Legend. World Soil Resources Report. Rome, Italy. 119 p.

Madsen, H. Breuning and Jones, R.J.A. (1995). Soil Profile Analytical Database for the European Union. Danish Journal of Geography, 95. 49-57.

INRA. 1995. Users guide for the elaboration of the European soil database, version 3.1. INRA publication. Orleans, France. 16 p.

Soil Survey Staff. 1996. Keys to Soil Taxonomy. Seventh Edition. 644 pp. USDA Natural Resource Conservation Service, Washington DC.

Soil Survey Staff. 1998. Keys to Soil Taxonomy. Eight Edition. 326 pp. USDA Natural Resource Conservation Service, Washington DC.

UNDP. 1995. Human Development Report: Albania. United Nations Development Program, New York. 54 pp.

Veshi, L. and Sh. Spaho. 1988. Pedology. Publication of the Agricultural University of Tirana. 574 pp. Tirana, Albania.

Zdruli, P. and H. Eswaran. 1994. Indicators of Soil Quality of Albania. Indicators of Sustainability. Conference and Workshop. Rosslyn, Virginia, USA. August 1 - 5, 1994.

Zdruli, P. 1997. Benchmark Soils of Albania. Internal monograph of the USDA Natural Resources Conservation Service, Washington DC and the International Fertilizer Development Center, Muscle Shoals, Alabama. USA. 2 Volumes. 293 pp.

Zdruli, P., Almaraz, R. and Eswaran, H. 1998. Developing land resource information for sustainable land use in Albania. Catena Verlag, 35447 Reiskirchen, Advances in GeoEcology 31, 153-159.