Management of Bulgarian soil resources fertility

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Introduction

Land use change in Bulgaria in the end of XX century after privatization has been recognized by decision makers as a primary concern to ensure sustainable development and political stability. Now agriculture of Bulgaria is the main source of the food export and Bulgarian society knows that the soil resources and their diversity need of care and preservation.

The Institute of Soil Science, as a main soil survey organization in Bulgaria was initiated in response to the perceived need to expand agricultural output at least to the point of self sufficiency.

The period 1950-90 was the really productive period for soil survey and the collection of information about the nature, distribution and properties of Bulgarian soils, helping us for development of an understanding of the main soil processes. Collected data and information in this period is now proving so important in helping to find answers to current environmental problems.

Land Capability Classification (Koinov et al, 1973) was developed and soil maps in scales 1:500 000, 1:400 000, 1:100 000 for Land Use Planning were also produced in recognition of the need to organize planning agriculture and to protect the agricultural lands.

In the mid-1970s to mid-1980s, Bulgaria became self-sufficient in staple agricultural products and there was a sharp decline in support for soil science because the discipline was inextricably linked to productive agriculture and further research was perceived to lead to even larger surpluses in the future. The importance of soil in the broader environmental debate, that was to follow, had not yet been appreciated.

Funding for soil surveys, including industrial soil contamination and destruction, urban sprawl, erosion, soil surface packing and sealing, declined and many soil survey programs were curtailed or stopped completely. The result was that Bulgaria had not completed its detailed national soil mapping program by the end of the 1980s, including soil map in scale 1:10 000 for all territory.

Present status of soils of Bulgaria

As a result of the soil forming processes, the soil map of Bulgaria shows a mosaic pattern of great variability of soils and more than 20 soil groups out of a total of 28 FAO soil map units, identified in the World soil resources, can be found on the relatively small territory of Bulgaria (Boyadzhiev,1994). For the last 100 years, collecting, preserving, updating and use of soil information have been the main aim of intense investigations of the Nikola Poushkarov Institute of Soil Science, involving soil survey, diagnostics, classification and mapping.

From the geographical and ecological points of view, the territory of the country can be divided into three large soil areas:

1) North Bulgaria soil area, which includes the soils distributed on the Danube plane and the Northern Balkan territories. Chernozems and Grey forest soils are widely presented there.

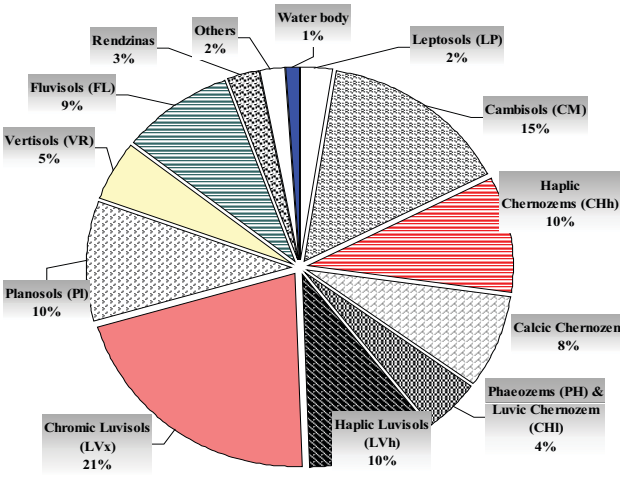
2) South Bulgaria soil area, which includes the soils distributed on the territoty of Southern Bulgaria. Cinnamonic forest soils, Smolnitza and Pseudopodzolic soils are presented there.
3) Mountainous soil area, which includes three main soil groups. Brown forest soils, Mountainous dark soils and Mountainous meaddow soils are mainly presented there.

The soil cover of Bulgaria has developed in different local forming conditions and soils have site-specific properties as well as the susceptibility to degradation. Land degradation processes, mostly soil erosion, really cover more than ¾ of the country territory (Russeva, 2002) and vary on intensively cultivated lands and on lands being in a natural state.

Continuous assessment of the soil properties, land degradation status and soil vulnerability and collection of soil and terrain data, are being carried out by the Nikola Poushkarov Institute of Soil Science, Sofia. By 1988 the soil cover of the entire territory of Bulgaria was mapped at 1:25,000 scale and soil maps at a scale of 1:10,000 cover almost the entire territory of Bulgaria. In addition, soil survey and maps at scales from 1:5,000 to 1:1,000 cover territories with particular problems, such as soil salinity and pollution with heavy metals, arsenic, oil products or radio nuclides. Bulgaria has its place in the European digital soil map in scale 1:1 000 000.

The most widely spread soil groups are Chromic Luvisol (21.91% of the country territory), followed by Chernozems (20.23%), Cambisols 15.58%, Haplic Luvisols (10.24%), Pseudopodsolic soils (9.75%), Fluvisols (8.97%), Vertisols (5.37%). Limited spreading has Rendzic Leptosol (2.74%) and Leptosols (1.55%). Least spread soil groups are Solonetz and Solonchaks (0.22%). The rest groups (Regosols, Arenosols, Calcisols and Anthrosols) could be found in association with the other soil groups (Fig.1).

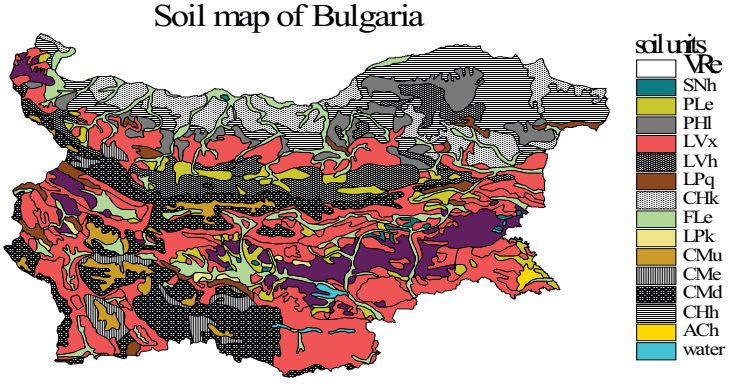
Fig. 1 Distribution of soil resources in Bulgaria (Koinov, 1973)



Bulgaria participated in the project of European Soil Bureau “Soil map of Europe 1:1 000 000 scale” and Fig. 2 shows a segment of the map for Bulgarian soils.

In addition to the soil survey, soil agrochemical survey and maps at a scale of 1:25,000 cover the arable lands of the country’s territory. The records of the agrochemical soil survey include information about the total and available forms of the macro- and microelements and data of the main soil physical and chemical characteristics. Based on this information had been organized a national system for agrochemical survey. The relevant information for the system is updated periodically.

Fig. 2. Soil map of Bulgaria as a segment of soil map of Europe at 1:1 000 000 scale (Stoichev and Kolchakov, 1998)



Main physical and chemical characteristics of soils

The realization of high productivity from the agricultural crops depends on the soil conditions and most of the soils in Bulgaria have naturally formed favourable agronomic physical properties in the upper (0-30 cm) horizon. Generally the soils from virgin lands are characterized with comparatively very good and good aggregate stability (>50-60% of water stable aggregates), optimal bulk density (1.0-1.3 g/cm^3), good aeration porosity (>10-15%v/v), good available water porosity (>15-20%v/v), and pH not limiting plant growth (Table 1).

Table 1. Physical, humus and pH status of 0-30 cm layer of virgin soils (Dilkova at al., 1998)

Soil groups	Clay	Humus	BD	MWDR	AWC	pHKCl
	%	%	g/cm3		%	
1. Haplic Kashtanozems	27	3.5	1.22	0.68	24.6	6.6
2. Chernozems	30	3.0	1.22	0.43	17.8	4.8
3. Haplic Luvisols	24	3.4	1.21	0.44	24.2	4.4
4. Chromic Luvisols	21	1.3	1.42	0.52	18.3	4.7
5. Eutric Planosols	17	2.6	1.25	0.59	23.9	4.3
6. Distric Planosols	13	1.9	1.38	0.39	20.5	4.6
7. Vertisols	44	4.3	1.18	0.44	25.9	5.6
8. Humic Cambisols	24	10.5	0.89	0.86	22.3	5.3

Very good | Good | Mean | Poor

The present humus status of the upper layer of the investigated soil types of the arable lands could be qualified as much deteriorated. The main part of them (86%) has a low (2-3%) and a very low (1-2%) organic matter content. Being under virgin conditions 36% of all investigated soil groups are characterized with high (4-5%) and medium (3-4%) humus content. As a whole, soils with low humus content do not change significantly their humus status after the transition from virgin to arable one.

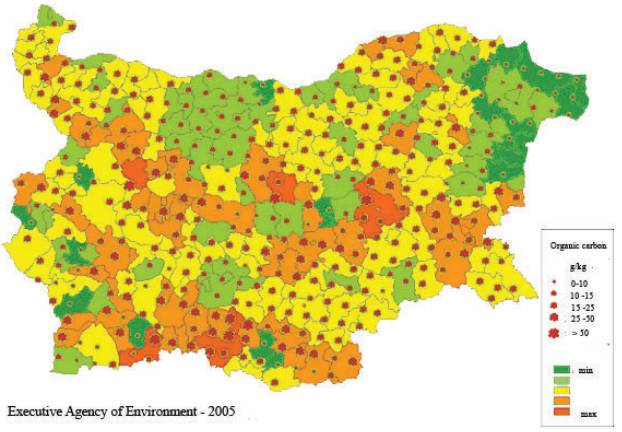
The most unfavourable anthropogenic change of the soil physical properties was the drastic diminishing of the aggregate stability and it is highly correlated with soil organic matter decreasing. At virgin conditions about 60 % of the investigated soils showed a very

good and good water stability of the aggregates, 37 % had a mean water stability of the aggregates and 3% - poor aggregate stability.

The soil aggregate stability have been deteriorated and have to be qualified as slight and more often as poor by the long-term agricultural use of the soils (Dilkova et.al, 1998). Approximately 4.3 millions ha are occupied by soils (Cambisols, Planosols, some Luvisols etc.) with genetically inherent acid reaction (pH<5.0), but only 0.45 millions ha of them are cultivated (Ganev, 1992).

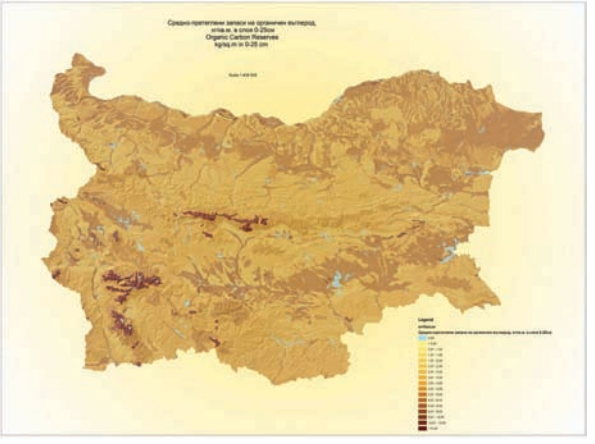
From 2005 the soil monitoring network of the Ministry of environment and water is in function. Parameters of this network were created in the Institute of Soil Science "Nikola Poushkarov". It is good base of investigations of organic carbon status in soil and the soil fertility (*Dinev, N., N. Kolev, S. Russeva, V. Koutev.(2003)*. Areas in which the application of organic manures and composts are well seen on the map.

Fig. 3. Distribution of organic carbon in the Bulgarian soil monitoring network



Another study on the organic carbon content in soil was carried out in the Institute (Filcheva E., Sv. Rousseva, A. Kulikov, 2007). According to the soil distribution a map with the reserves of organic carbon was created (Fig.4).

Fig. 4. Organic carbon reserves in Bulgarian soils 0-25 cm layer



Some aspects of present status of land degradation

The agricultural lands cover more than 60% of the territory and most of them are under anthropogenic impacts (Stoichev and Kolchakov, 1996; 1997; Bullok, 1999; Stoychev et al, 2000). Issues like industrial soil contamination and destruction, urban sprawl, erosion, soil surface packing and sealing are threaten vulnerable soil resources.
Land degradation processes in Bulgaria really cover more than ¾ of the country territory and vary on intensively cultivated lands and on lands being in a natural state (forests and grasslands). Erosion, decline of organic matter and soil contamination have been recognized as the most widespread soil degradation threats, which limit severely the multi-functionality of this non-renewable natural resource. An effective programme of action to combat these degradation processes requires a robust information base on current status and trends of soil degradation phenomena.

Dilkova et al. (1998) and Stoichev et al. (2000) presented data for organic contents measured in soil samples from virgin and arable lands, representative for the main soils distributed on the country's territory. Analyses of those data show that compared to the virgin soil, the decline in organic matter in the arable lands ranges from 15 to 38 % depending on the soil type. Appropriate application of organic wastes is the only reasonable technology for improvement of organic matter status of Bulgarian soils.

Soils differ widely in terms of their capacity to support environmental, productive and other functions. The ability of Bulgarian soils to recover from damage also varies and it depends strongly on organic mater content in soils. The extent of potential damage to functions presented by hazards varies between soil types, while the impact of losses in soil function depends on the actual or possible uses of soil. Protective measures need adequate descriptions, for each soil class, of the relevant current, possible or most important functions, potential hazards to the delivery of these functions, and the risk these hazards present to future soil use. An effective soil policy must allow for the matching of protective measures to soil types considering the land use.

Conclusions

Analysis of the driving forces and the current state of soil resources in Bulgaria shows that soil erosion, decline in soil organic matter, soil compaction, sealing and crusting are processes, which neglect can result in a serious negative impact on the land productivity potential. Pollution with heavy metals and radioactive nuclides, acidification and salinization has local character. It is important that large territories of the country are with high quality soils and suitable for producing environmentally clean production.

Development of national and regional programs for introducing and stimulating environmentally agricultural practice will result in prevention from further land degradation and recovery of the soil productivity potential.

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