Threats to Sustainability of Soil Functions in Central and Southeast Europe

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Many of the fertile lands located in semi-arid to semi-humid regions that provided the most favourable sites for the early development of human culture and were once used by archaic civilisations are now buried in debris, because of destructive treatment of the lands by humans.
Göbekli Tepe is situated on a flat and barren plateau located in Southeastern Anatolia Region of Turkey. Dating back to the 10th-8th millennium BCE, the plateau has been transformed by erosion and by quarrying, which took place not only in the Neolithic, but also in classical time.
A very large Neolithic and Chalcolithic proto-city settlement in southern Anatolia, which existed from approximately 7500 BC to 5700 BC, and flourished around 7000 BC.

People in Çatalhöyük had skills in agriculture and the domestication of animals.

They grown cereals such as wheat and barley, as well as peas, almonds and pistachios.
The capacity of a soil to function, within ecosystem and land-use boundaries, to sustain biological productivity, maintain environmental quality, and promote plant and animal health.
The primary threat to soil quality in CASEE countries is related to human activities.

- nutrient imbalance,
- depletion of soil organic matter,
- accelerated water and wind erosion,
- soil compaction by both farm machinery and grazing,
- salinization,
- waterlogging,
- contamination,
- acidification,
- landslides and
- soil sealing.
A Decline in OM began centuries ago and has shown higher levels of decline in three periods: the era of multi-ploughing (in the 1800s), the 1960s, and the 1990s.

These three periods are associated with the start of the deeper ploughing, the decade of the early intensive land use, and the first years after land privatisation in CASEE countries.
LIMING

IRRIGATION

DRAINAGE

DEEP PLOUGHING
Removing plant residues by either burning stubble prior to ploughing or gathering the material (e.g., cotton and bushy pasture plants) for firewood also contributed to OM decline.
• while cultivated agricultural fields increased by about 80% from 13.3 to 24 Mha.

• Pasture area in Turkey decreased by approximately 47% between 1938 and 1991 falling from 41 to 21.8 million hectare (Mha),
In Romania:

- The reduction of organic matter and macro-nutrient content affects more than 3.3 million ha representing 14.1% of total country surface.
- Soil organic matter losses ranges between 45 and 90% of the total organic matter pool in the soil.
- The soil organic matter losses at the country level are estimated at 500,000 tonnes per year.
✓ **Soil erosion** is one of the major and most widespread threat on soil quality. Incorrect soil management practices led to physical degradation of soils and are the major causes for water and wind erosion.

✓ Erosion occurs in Agricultural lands within almost every CASEE country, even those with flat topography such as Lithuania or the other Baltic States.

✓ Soil erosion occurs in vast areas of Ukraine with 41% (17 million ha) of agricultural land.

✓ In the Balkan Peninsula, particularly in Bulgaria and Romania, around 40% of land is affected by soil erosion.

✓ In some countries, water erosion is very severe and may lead to desertification of lands (e.g., Bulgaria, Romania, Albania, Slovenia, FYR of Macedonia, Georgia, etc.).
Deforestation, improper irrigation and conventional tillage practices led to increasing rates of soil erosion for a long time in Turkey.
• Land of Turkey is very sensitive for desertification, due to her climate, topography, soil characteristics and human activities.

• 59% of the agricultural land, 64% of rangeland and 54% of forestland are subjected to erosion in Turkey,

• Approximately 180 million tons of sediments are transported to seas and lakes every year from Turkey.
Wind erosion is common in the plains of the arid and semi-arid climatic regions, as well as on sandy and silty soils of other regions of CASEE countries. 

Wind erosion occurs throughout the year on bare lands, and mainly in the spring and summer months on the overgrazed rangelands and over-cultivated/tilled soils.
• Wind erosion is site-specific, especially for the southern part of Romania.
• The absence of irrigation and uncontrolled deforestation of protection belts accelerated the northward extension of desertification-affected surfaces and movement of sand dunes.
Soil Compaction

Compaction can cause a serious reduction in water penetration and seedling emergence.

Primary cause is an increase in field traffic.

Globally, more than 68 million ha of land are classified as compacted, with 4% being associated with anthropogenic soil degradation.

In Europe alone, compaction accounts for about 17% of the total degraded area.
Soil compaction represents damage of several soil physical properties, including the breakdown of soil structure, decreased loosening, limited water transport and consequently higher risk for water erosion and drought stress.
Soil Compaction

• Annual yield losses due to soil compaction in Turkey were over one billion US dollars ($).
• In many CASEE countries, compaction became a very serious degradation agent as the size and weight of farm machinery increased.
• For example, since 1955 the mass of tractors and tillage implements have increased by 68 and 200%, respectively in the Czech and Slovak Republics.
• Soil compaction and crusting are most prevalent in the plains region of southern and western Romania, where use of heavy machinery is widespread.
• Unfortunately, farmers in many CASEE countries are not aware of the seriousness of subsoil compaction.
Soil Compaction

- Restoring drainage, increasing plant nutrition, and improving irrigation systems can sometimes mask the detrimental effects of subsoil compaction on crop production,
- But those temporary solutions for preventing yield reduction due to compaction often increase expenses for farmers and contribute to environmental problems due to increased use of water and nutrients.
Salt-induced land degradation is a major drawback to optimal functioning of soils in arid and semiarid regions of CASEE countries.

For example, in Romania 4% of the total agricultural land was affected by salinisation in 2002.

Unsustainable irrigation practices and inappropriate water management at the farm-level stimulates rising the groundwater and contributes to salt accumulation, particularly in irrigated fields of arid and semi-arid regions, and eventually causes to salt-induced land degradation.
Salinity and sodicity were detected on 1,518,722 ha of the land resource in Turkey.
Saline soils constitute a large part of the barren lands (74%).
The barren lands in Turkey have a size almost equal to 2% of the total surface area, 5.48% of total cultivable land and 17% of the 8.5 million ha of economically irrigable land.
Salinization

- Harran Plain (120,000 ha) which was first opened plain for irrigation in 1995, because of prior excessive and uncontrolled irrigation, an insufficient and uncared for drainage system, and an increase in the groundwater level caused by the improper irrigation management practices
Localized flooding is a serious problem, associated with extreme rainfall and unpredictable rainy periods.

The frequency of floods seems to have increased over the last decade in all CASEE countries, maybe in response to global climate change.

In 2005, the surface exposed to flood danger in natural regime of flow was up to 30,000 km², representing about 13% of the Romanian territory.
Soil contamination is another important threat in the CASEE countries due to rapid industrialisation and urbanisation and the fact that soils are often used for the disposal of industrial and urban waste products.
Soil Contamination

- Heavy metal pollution was encountered in only certain hot spots,
- But soil acidification and soil erosion problems were noted throughout the country.
- Heavy metals in Czech Republic was also similar to other CASEE countries with high heavy metal concentrations generally being associated with long term industrial emissions.
- Soil pollution show a manageable rate in some countries (e.g. Czech Republic, Hungary, Slovak Republic).
- Acidification, both natural and anthropogenic, is the most widespread type of soil contamination in central European countries, with especially large areas having been identified in Poland and Ukraine.
Soil sealing in Romania between 1989 and 1994 increased almost 19%.

Based on the report published by Institute of Regional Development Planning, University of Stuttgart, in 2012, 45% of the land area in Hungary was sealed.

http://www.eea.europa.eu/articles/urban-soil-sealing-in-europe
Occupation for settlements and industrial purposes of high quality lands in Turkey has almost reached to 172,000 ha.

http://www.eea.europa.eu/articles/urban-soil-sealing-in-europe
Towards to the Sustainability

- Soil deterioration has occurred for centuries primarily due to “conventional” soil management in agricultural fields.
- When the processes causing to deterioration of soil quality are traced and controlled, soil-use and soil quality remain sustainable on the long run.
- The concept of sustainability has environmental, economic and social aspects and also an institutional dimensions.
- Therefore, processes affecting these issues should be taken into account to maintain sustainability of soil health.
Twelve factors for the fundamental requirements of the sustainable soil tillage

1. Avoiding the farming and tillage-induced soil damages

2. Maintaining soil moisture transport by improving the water infiltration and storage in wet periods and decreasing the moisture loss in dry and average seasons.

3. Preserving organic material of the soil to increase the water-holding capacity, the structure stability, the loading capacity and the workability and to decrease the soil compactibility and vulnerability.

4. Managing stubble residues by application of harvest and tillage techniques leaving mulch cover on soil surface.
5. Recycling stubble residues to the soil for the sake of the soil organic matter improvement, promoting the favorable biological activity.

6. Utilizing the possible machinery and arable site factors to reduce the energy consumption thus to decrease the environmental load.

7. Minimizing the soil loading stress from stubble to sowing phase

8. Applying optimal crop sequence to reduce fertilizer needs and to improve soil biological activity through the crops effect on soil condition.
9. Particular attention is to be paid to maintain the soil infiltration and storage capacity and the soil aggregation on irrigated soils,

10. Applying tools without pan-creation in any tillage procedures, particularly in wet soils,

11. Assessing the possible risks cautiously prior to establishment of the new tillage and sowing systems, and

12. Selecting the most adaptable soil conservation methods which are conformed to the site and crop production requirements.
Conclusions

• Since the degradation of lands cannot solely be accounted for physical or technical causes, **social and political dynamics of degradation** along with the activities threatening soil quality of CASEE countries as in everywhere should be controlled by laws and regulations which are the most important instruments in relation to preventing soil degradation.

• Environmental awareness and improved socio-economic status of people in rural areas are also important measures to adopt new conservative agricultural practices among farmers.
Conclusions

• The negative effects of unfavourable agricultural management systems on environment originate from the single farm levels, therefore adaptation of tools improving soil quality is needed on this level.

• The main limitations of the uncertainty of the soils sustainability can also be taken back the economical situation causing a fluctuation in the agricultural activities, including soil remediation.
THANK YOU...