

LAND QUALITY AND PRODUCTIVITY ASSESSMENT DATABASE CONCERNING THE AGRICULTURAL LAND OF ION NECULCE COMMUNE, IAȘI COUNTY

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Abstract

Agricultural land quality and productivity assessment relies both on soil fertility, which is undoubtedly the most important factor, and on climate, relief and hydrology factors. Soil quality is affected to a higher or lesser extent by one or more restrictions determined either by natural factors, or by agricultural and industrial anthropogenic actions, which may have a negative synergistic influence, the effect of which is a decrease in soil quality and even the abolition of its functions. This paper tackles the soil mapping surveys and the climate, relief and hydrology conditions in the Ion Neculce administrative-territorial unit, Iași County. From the climate point of view, the surveyed unit belongs to the temperate climate, with an average annual temperature of 9.5°C and average annual precipitations of 502 mm, which fall unevenly. The relief is mostly hilly, the biggest area of 6108 ha is located at altitudes ranging between 100 and 200 m, whereas 114 ha at altitudes ranging between 200 and 300 m. The water system is relatively dense and belongs to the Bahluiet river basin, a characteristic being the intermittent watercourses and the presence of temporary ponds in the depression areas. The productive capacity of the soil on the mapped area of 6338 ha is affected by surface erosion (53.35%), landslide (27.74%), gullies (1.12%), gleying (14.11%), stagnogleying (0.56%) and salinization and alkalization up to 26.25% of the surveyed area. The Ion Neculce Commune soils belong to the Chernisols (69.45%), Antrisol (14.04%), Protisol (9.91%), Luvisols (3.40%), Hydrisols (1.92%) and Salsodisols (1.28%) classes.

Keywords: agricultural land evaluation, gleying, stagnogleying, erosion, landslide

MATERIAL AND METHOD

The rational exploitation of soil resources requires an intimate knowledge of soil properties, but also of the features of all the environmental factors.

In its capacity of primary natural resource for agriculture, the soil is a basic constituent of the continuity and prosperity of rural inhabitants, and hence of the prosperity of the entire nation, which compels us to preserve and make the best use of this natural capital.

Soils are the most valuable wealth, the most precious asset, which needs to be known and acknowledged, preserved and used at its real potential (Hera C., 2008).

The harmful effect of soil quality as a consequence of the negative influence of the factors regarding the climate, relief, hydrology, soil characteristics has been assessed under various intensities over 7.5 million ha of arable land, which represents around 80% of the arable surface of Romania (Dumitru M. *et al*, 2006).

From an administrative viewpoint, the Ion Neculce Commune territory belongs to Iași County, whereas geographically, it is located on the southern border of the Jijia Hilly Plain, where the latter meets the Iașilor Flank, which determined the complexity of the natural factors and their numerous combinations.

The Ion Neculce Commune is located to the west of the county, about 40 km from Iași City and includes the following villages: Ion Neculce, Războieni, Gănești, Buznea and Prigoreni (*fig. 1*).

The total area of the Ion Neculce administrative territorial unit is 7148 ha, of which 6300 ha of agricultural land and 848 ha of non-agricultural land.

The soil survey conducted by O.S.P.A. Iași was carried out on 6338 ha, which include both agricultural and non-agricultural land in the commune. The geomorphological features and processes of Ion Neculce commune were identified both through traditional research methods (observations and field measurements, geomorphological mapping, statistical and mathematical processing, analysis, synthesis) and modern methods based on GIS software.

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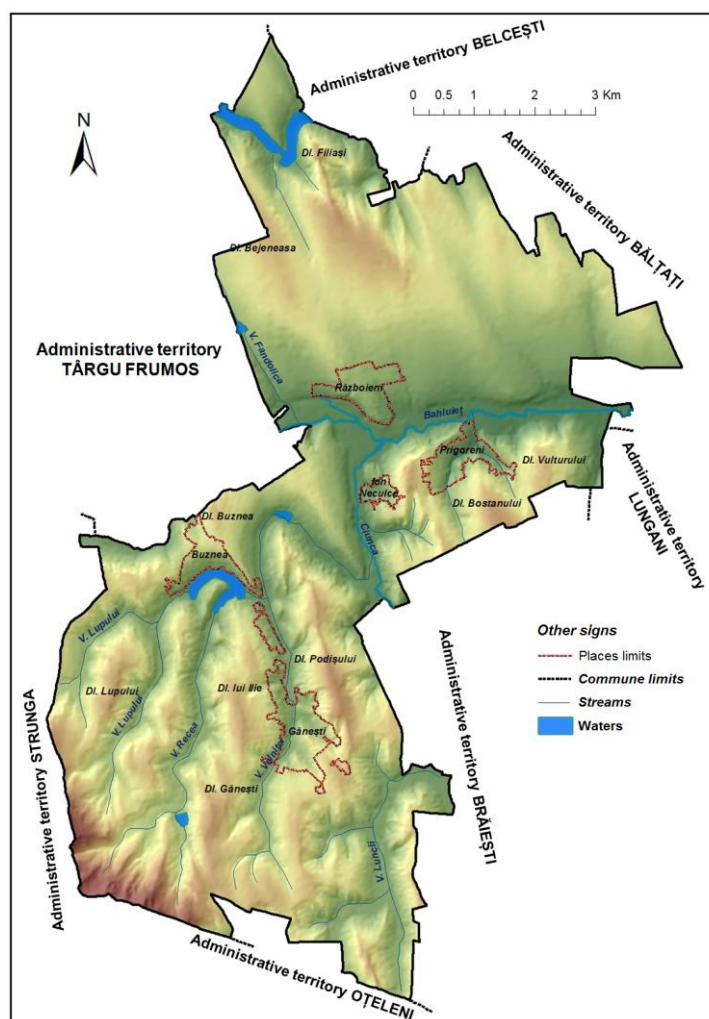


Figure 1 Administrative Location of Ion Neculce Commune

The cartographic material was collected by using the TNTmips v.6.9 and ArcGIS v.10.1 programs. An important stage in spatial modeling was the development of the Digital Terrain Model (DTM), by the vectorization of the contour lines on the topographic plans at a 1:25 000 scale. Thematic maps were created based on vectorized contour line processing.

RESULTS AND DISCUSSION

The pedo-climatic and geomorphological constraint in use of the Ion Neculce commune lands requires thorough research of the soil fertility status and identification of the main limiting factors of the agricultural production in order to establish necessary agropedameliorative measures for the proper implementation of the Code of Good Agricultural Practice.

Out of the multitude of environmental conditions, evaluation marks of farmland regarding natural conditions take into account the most important factors, namely: climate, relief, hydrology and soil.

a) Climate

The Ion Neculce Commune climate is temperate, with an annual average temperature of 9.5°C.

The minimum absolute temperatures which drop below 0°C are recorded starting with the second decade of September, at the earliest, and may extend as much as the last decade of May, at the latest. Minimum absolute temperatures below -28°C may be recorded in December, January and February.

The annual average precipitations amount to 502 mm, and they fall unevenly, June being the rainiest of the whole year. During the warm season precipitations come out in torrents, especially in summer, when they come out in pouring rains. The large amounts of precipitations fallen within short time intervals cause flooding and soil erosion in summer and snow drifts in winter. Drought and hailstone are the negative weather events related to precipitations which occur frequently.

In this area the winds blow along the Bahluiet Valley, the ones blowing from the north-west and north, in winter, and from the south-east, in spring, are the strongest.

b) Relief

The local relief is typically hilly, strongly influenced by the evolution of the Bahluiet subsequent valley, in generally monocline structure specific to the Moldova Plateau, sculptured for the most part. The altitudes decrease from both the northern and southern extremities towards the Bahluiet River course, from about 200 m to under 100 m (*figure 2*).

Most of the commune land, i.e. 6108 ha (85.45%), is located at altitudes ranging from 100 to 200 m, 926 ha (12.96%) at altitudes not exceeding 100 m and 114 ha (1.59%) at altitudes ranging from 200 to 300 m.

The Basarabian rock structure, which is specific to the Central Moldavian Plateau, the relief consisting of a mixture of hills and hillocks,

as well as the continental temperature climate, and also the human action are some of the natural and anthropogenic factors which have led to 28.86% of the mapped area, i.e. 1829.33 ha, being affected by landslides and gullies (*figure 3*).

Landslides take up 1758.16 ha, i.e. 27.74% of the mapped area. There are several types of landslides:

- stabilized landslides 1075.22 ha, i.e. 61.16% of the entire area affected by landslides;
- semi-active landslides 417.51 ha, i.e. 23.75%;
- active landslides 265.43 ha, i.e. 15.10%.

Gullies take up 71.17 ha, i.e. 1.12% of the mapped area.

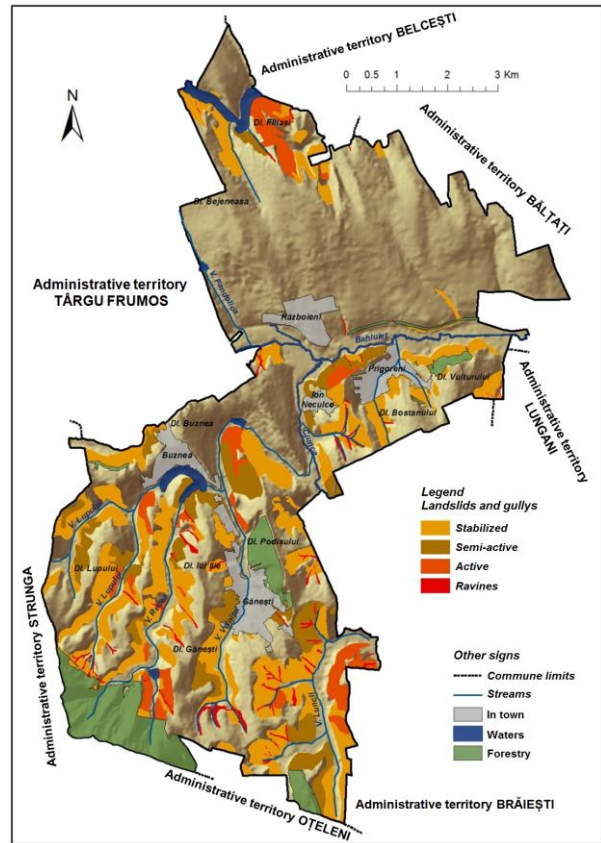
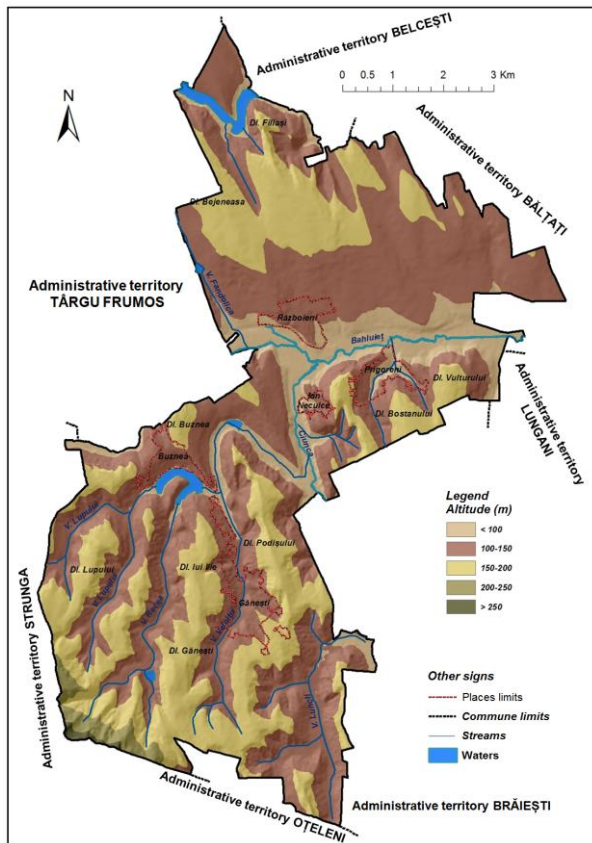


Figure 2 Distribution on Altitude Figure 3 Landslides and Gullies

The relief is extremely important in land quality and productivity assessment due to the land gradient. The Bahluiet depression, narrow valleys and interfluvial plateau peaks have slopes with gradients that do not exceed 5% (2078.45 ha) and they make up 29.08% of the total commune area of 7148 ha (*figure 4*). Most versants, i.e. 4218.64 ha (59.02%), have slope gradients ranging from 5 to 20%, which is an important indicator when establishing the land quality and productivity grade. A small area of 850.65 ha of the upper

versants, making up 11.90% of the whole commune area, has slope gradients that exceed 20%.

Exposure is important when assessing land quality and productivity due to the precipitations and heat differences, and it determines certain soil characteristics. Thus, the soils on sunny (S-SV) and semi-sunny (V-SE) versants, which enjoy more sun radiation and are thus warmer and drier, are thinner than the soils on shady (N-NE) and semi-shady (E-NV) versants.

Shady versants (N-NE) make up 31% (2208 ha), the semi-shady versants (E-NV) account for 22% (1552 ha), the sunny versants (S-SV) take up

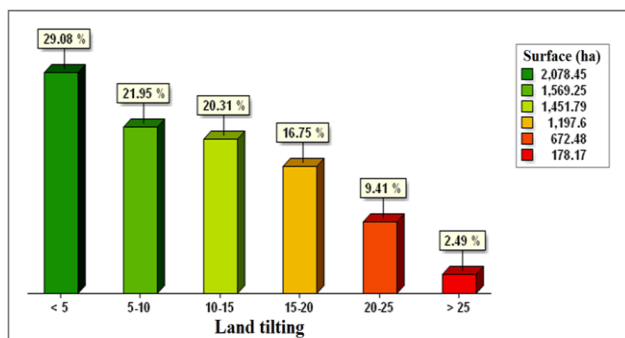


Figure 4 Share slopes

26% (1851 ha) and the semi-sunny versants (V-SE) extend on 21% (1537 ha) of the Ion Neculce Commune area (figure 5).

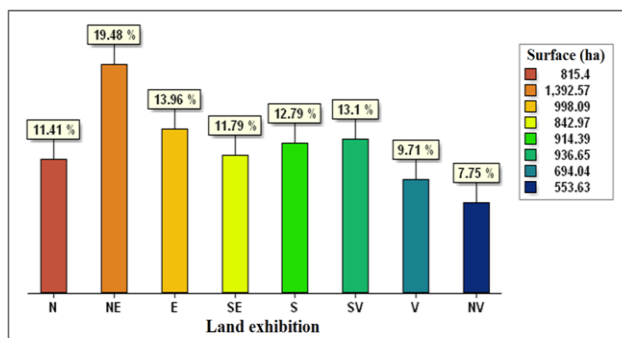


Figure 5 Share exhibition

c) Hydrology

The river system is relatively dense and related to the Bahluiet basin, being characterized by intermittent water courses and temporary pools in the depression areas. This area has a Jijia-like hydrological regime, which is specific to the lower relief area (Jijia Hilly Plain), with moderate pluvio-nival and underground water supply. The months of February and March are the major floods months.

In the upstream area from Târgu Frumos, as the valley deepens in its own alluvium, the floods are rare or inexistent, whereas in the downstream area the ponds overflow and the stream bed is barely deepened, which makes the depression easily floodable.

Groundwater is closely dependant on the geological and physical-geographical conditions. From this point of view, we may distinguish between groundwater in eluvial matter coming from sculptural interfluvies located at various depths, which are involved to a small extent in water flowing towards rivers, groundwater in deluvo-colluvial deposits coming from versants, which a higher mineralization degree during the dry periods and which are involved to a greater extent in river supply. The groundwater in cumulative terrace deposits is the most important and occurs at the foot of the versants (terrace fronts), to the left of the Bahluiet River, downstream from Târgu Frumos. They supply the Bahluiet River continuously and are slightly alkaline. Groundwater in cumulative depression deposits remains at the foot of the depression and there is a permanent water exchange, which goes both ways, between groundwater and the stream bed of the brooks.

d) Soil

The fertility of the soil in the Ion Neculce Commune is influenced by the following limiting factors: surface erosion, gleying, stagnogleying, salinization and alkalization.

Surface erosion intensity is directly proportional to the gradient and shape of the versants, to their length and surface area, and it is influenced by petrographic structure, land use, plant cover, etc.

In the Ion Neculce Commune, surface erosion affects 3381.04 ha, i.e. 53.35% of the mapped area (figure 6).

We distinguished the following types of erosion:

- mild erosion – 1808.46 ha (53.49% of the area affected by erosion);
- moderate erosion – 658.20 ha (19.47%);
- strong erosion – 267.41 ha (7.91%);
- very strong erosion – 646.97 ha (19.14%).

The water table present at a critical depth, a mildly deepened stream bed and a poorly permeable lithological substrate, together with the presence of pools and lakes, have led to 14.11% (894.42 ha) of the mapped area to suffer from excessive humidity due to the water table (figure 7). 23.31% (208.47 ha) of the impaired area exhibits mild gleying, 25.04% (223.98 ha) moderate gleying, 40.12% (358.85 ha) strong gleying and 11.53% (103.12 ha) excessive gleying.

The presence of the hardly permeable horizon has determined mild stagnogleying in 35.63 ha (0.56%) of the mapped area.

Salt-bearing river deposits determine the mineralization of the water table at small depth, which causes salinization and alkalization in the lower soil horizons. By contrast, in summer, these phenomena are more marked even in the upper horizons.

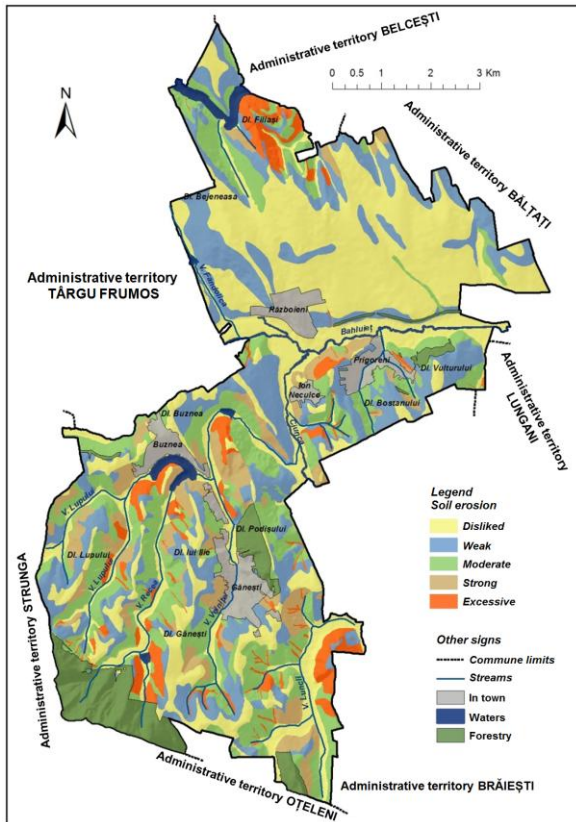


Figure 6 Surface Erosion Distribution

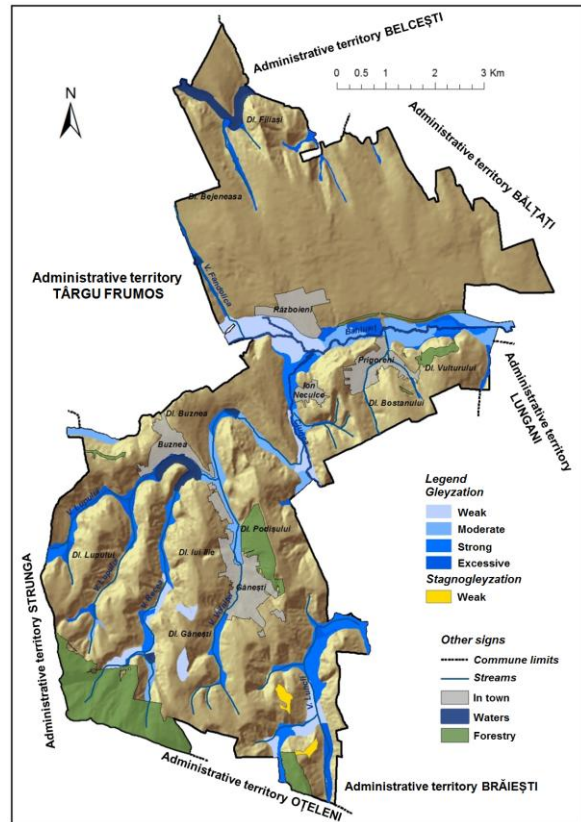


Figure 7 Gleying and Stagnogleying Distribution

Soil salinization and alkalization occur especially in the Bahluiet depression and affect 1663.78 ha, i.e. 26.25% of the mapped area (figure 8), in the following manner: 335.14 ha mild salinization, 761.24 ha partial mild salinization, 92.54 ha mild salinization and mild alkalization, 195.82 ha mild salinization and moderate

alkalization, 27.79 ha moderate salinization and mild alkalization, 36.16 ha moderate salinization and very strong alkalization, 11.31 ha strong salinization, 173.76 ha strong salinization and mild alkalization and 30.22 ha strong salinization and very strong alkalization.

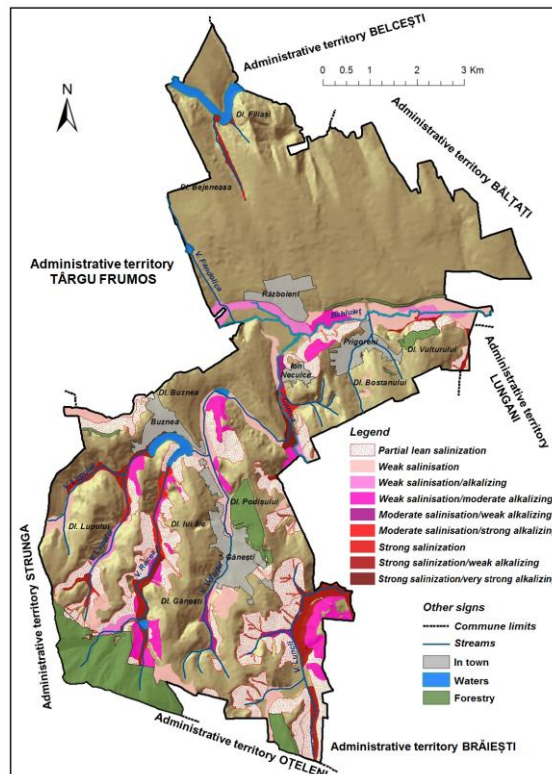


Figure 8 Salinization and Alkalization Distribution

The soils of the Ion Neculce administrative territorial unit were assessed based on the Romanian Soil Taxonomy System (SRTS) developed in 2012. On the 6338 ha mapped area, we identified 76 simple soil units and 14 complex soil units belonging to the following classes: Chernisols (69.45%), Antrisol (14.04%), Protisol (9.91%), Luvisol (3.40%), Hydrosol (1.92%) and Salsodisols (1.28%).

For soil assessment purposes, the classification was complemented with ecological considerations by recording the edaphic parameters, degradation risks, as well as by grouping soil units on pedoclimatic micro areas and including the thermo-hydric criterion in soil classification.

CONCLUSIONS

The commune climate is temperate continental, with an average annual temperature of 9.5°C and average annual precipitations of 502 mm, which fall unevenly.

The relief is typically hilly, the biggest area, i.e. 6108 ha (85.45%), being located at altitudes ranging from 100 to 200 m, 926 ha (12.96%) at altitudes not exceeding 100 m and 114 ha (1.59%) at altitudes ranging from 200 to 300 m.

The land gradient is below 5% on an area of 2178 ha (29%), ranges from 5 to 15% on 3021 ha (42%), from 15 to 25% on 1870 ha (26%) and exceeds 25% on 178 ha (3%).

Landslides were identified on a total area of 1758 ha, which make up 28% of the mapped area, of which 1075 ha are stabilized landslides and 683 ha are semi-active and active landslides.

The river system is relatively dense and related to the Bahluiet basin, being characterized by intermittent water courses and temporary pools in the depression areas.

Surface erosion occurred on 3381 ha, i.e. 53% of the mapped areas, of which 1809 ha are affected by mild erosion, 658 ha by moderate erosion, 267 ha by strong erosion and 647 ha by excessive erosion.

The pedoclimatic and geomorphologic conditions caused mild gleying on 3.2% (208 ha), moderate gleying on 3.5% (224 ha), strong gleying on 5.6% (359 ha) and excessive gleying on 1.6% (103 ha) of the mapped area.

Salt-bearing river deposits located close to the surface cause salinization and alkalization phenomena of various intensity degrees, which occur especially in the Bahluiet depression and in the narrow valleys, affecting an area of 1664 ha, i.e. 26% of the mapped area.

The Ion Neculce Commune soils belong to the Chernisols, Antrisol Protisol, Luvisol, Hydrosol and Salsodisols.

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