PRESENT ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, VOL. 5, no. 1, 2011

SOIL RESOURCES AND RISK FACTORS IN THE ADMINISTRATIVE TERRITORY OF ȚIBUCANI COMMUNE, NEAMȚ COUNTY

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Key words: soil resources, natural and anthropic risk situations.

Abstract: The administrative territory of Țibucani spreads on both banks of Umbrari brook, right side tributary of Moldova. It is a territory in which dominate agricultural usage of lands, from which arable terrains detain a percentage of 70 %, pastures 12% and forests 10% of the total. From a geomorphologic viewpoint, the territory belongs to the Moldavian Tableland and extends on two of its sub-units: the Moldova – Siret corridor to the east and the Peri-Carpathian Piedmont Hills to the west. The dominant relief is of cuesta type. On the cuesta reverse dominates a slow evolution, in the presence of sheet erosion. On the cuestas and the upper basin of Umbrari erosion is intense and accompanied by landslides, gully erosion, landfalls, consequence of the presence of loams and loess-like materials that favor the development of erosion processes. The diversity of soil forming conditions has led to the formation in this territory of a soil cover with large areas at the terraces' level and on the cuesta reverse, and reduced extension areas, more diverse as typology, at the level of the piedmont hills. In consequence, the largest extension is held by Luvisols, with a percentage of 47.59%, followed by Chernisols (22.48%) and Protisols (19.13 % of the territory). On the overall, have been identified eleven risk factors (limitations) that affect the productive capacity of terrains or hardens the life conditions of the population.

Introduction

Țibucani commune is located in the north-eastern part of the county, east of Corni Hill, up to Moldova River. It occupies 4970 ha, among which the agricultural terrains detain 4215 ha and the rest of 765 ha have other utilization. In the exterior of the built area, agricultural and unproductive terrains make up 3686.09 ha, on which the soil survey has been conducted.

1. Natural conditions

From a geomorphologic viewpoint, the territory belongs to the Moldavian Tableland and extends on two of its sub-units: the Moldova – Siret corridor to the east and the Peri-Carpathian Piedmont Hills to the west. The maximum altitude in

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the territory is of 463 m in Haitău Hill, and the minimum is of 250 m, in east, on Moldova River. Thus the relief energy is of 213 m.

The Moldova – Sire river corridor is represented by a series of accumulative terraces, the lowest being at 5-7 m relative altitude and the following at 12-15 m and 30-35 m, all having relatively clearly delineated foreheads. At the entrance in Moldova's floodplain, Rădeanca and Umbrari valleys have alluvial fans developed at the level of the 12-15 and 30-35 m terraces, whose clayey lithology favors the development of swelling processes. Each terrace has specific soils. Thus, on the 5-7 m terrace dominate Aluviosols, on the 12-15 m are present Chernisols and Vertosols, while on the upper terrace of 30-35m are extended Phaeozems and Eutric Cambisols.

The Peri-Carpathian Piedmont Hills are represented by summits that descend from the massive hill of Corni, and drained in our area by Umbrari valley. The dominant relief type is that of cuesta, generated by the action of Umbrari valley, that has a direction perpendicular to the geological structure, situation that leads to a left bank of the valley being elongated and affected by sheet erosion, while the right bank is moderately-strongly inclined and, due to the weak slope equilibrium, intensely affected by landslides and gullies. On the cuesta reverse dominate Luvosols, Preluvosols and Phaeozems. On higher declivities and the cuesta forehead are present Regosols and Erodosols.

In the western extremity of the territory, the summit that separates the Țolici and Umbrari valleys is reduced up to the level of an intersection crest, due to the extension of torrential valleys and of landslides generated by the disruption of slopes' equilibrium.

Terrain slope is manifested on a large declivity span:

- terrains with slopes < 2.0 % , occupy 1628.21 ha, meaning 44.17 %;
- terrains with slopes between 2.1- 5.0 % , occupy 557.10 ha, meaning 15.11 %;
- terrains with slopes between 5.1- 10.0 %, occupy 629.24 ha, meaning 17.07 %;
- terrains with slopes between 10.1- 15.0 %, occupy 509.05 ha, meaning 13.81 %;
- terrains with slopes between 15.1- 20.0 %, occupy 225.57 ha, meaning 6.12 %;
- terrains with slopes between 20.1- 25.0 %, occupy 95.22 ha, meaning 2.58 %;
- terrains with slopes between 25.1- 35.0 %, occupy 36.95 ha, meaning 1.01 %;
- terrains with slopes between 50.1- 100.0 %, occupy 4.75 ha, meaning 0.13 %.

Easily can be remarked the extension of declivitous surfaces (40.72 %) of over 5% slope, which favor the occurrence of geomorphic processes represented by sheet and gully erosion and by landslides.

Sheet erosion affects 1323.47 ha of the territory, meaning 35.90 %, of which with weak intensity are 992.50 ha (26.93%), with moderate 324.67 ha (8.80 %) and excessive intensity 6.30 ha, and meaning 0.17 %. On 1.23 ha (0.03%) of the territory are met soils affected very intensely by decopertation. Landslides occupy

495.01 ha (13.43%) and occur as stabilized – 182.32 ha and semi-stabilized waves – 306.69 ha. Gully erosion is present on 468.15 ha (12.70 %), being present rills and gullies, largely extended north of Schitul Țibucani.

From a geological point of view, in the area can be delineated three regions. West of Țibucanii de Jos are present Basarabian deposits, made of an alternation of clays, marly clays, clayey marls and sands, with intercalations of sandstone, limestone and gravels. Towards east are present Pleistocene deposits represented by sands, gravels, loams and swelling clays, corresponding to the middle terraces of Moldova. At the floodplain level are met fluvial deposits, sometimes covering fluvial gravels, which have been parent materials for Aluviosols and Gleysols.

Hydrologically, the territory belongs to the basin of Moldova river. Umbrari brook, which springs from Corni Hill, traverses the territory from west to east and flows into Moldova on the territory of Miroslăveşti commune in Iaşi County. Underground water on the 5-7 m relative altitude and along the Umbrari brook has depths of 0-5 m, fact that led to the occurrence of gleyzation on 555.98 ha.

The climate of the territory is boreal, with chill and rainfall-rich summers and harsh snows, abundant in snowfall. The transition seasons are cold and humid. The mean temperature is of 8.2ºC, with a maximum of 19.3ºC in July and a minimum in January of -3.5ºC. The mean annual precipitations are of 629.7 mm, with the largest quantity in May, June, July, when are registered 288 mm, representing 44% of the total. The least precipitations fall during November-January. The mosr frequent winds are those from NW, SW, N and S, and the most intense are those from N, NW and W. According to the Koppen classification, the territory belongs to the D.f.b.k province.

The natural vegetation of Țibucani commune enters the forest area, the oak sub-zone. Forests are made of hornbeam, beech, oak, field maple, sycamore.

In the pastures are met associations of leguminous and forage plants, with *Agrostis tenuis, Cinosurus cristatus, Festuca rubra, Trifolium, Lolium, Lotus cerniculatus, Taraxacum, Plantago, Dactylis glomerata*. On the excessively humid pastures are present species such as *Equisetum, Mentha, Carex, Ranunculus, Scirpus*.

The territory of Țibucani commune has a dominant agricultural character, 85% of the terrains being cultivated or used as pastures. The present use of terrains has been maintained mainly at the level of Umbrari brook's floodplain, on the middle terraces and the piedmont hills. The pasture terrains have been maintained on the old locations and have lately increased in the disadvantage of isolate arable parcels or in the west part of the commune. On the high slope terrains is needed the use of anti-erosional agricultural techniques.

Humans, through deforestation, have allowed taking terrains into arable usage

Soil type	Surface Ha	Texture class Surface Section		Sheet erosion	Gully erosion	Landslides	Parent materials	Depth of rock	Decarbonat ation	Clay elluviation	Gleyzation	Stagno-gelyzation	Total porosity	Permeability	Upper horizon pH	Humus reserve
VERTOSOL	32.60	a-32.60	t-22.30 a-10.30	00–32.60	00–32.60	00–32.60	SG-32.60	>150–32.60	K2–10.30 K3–22.30	00–32.60	2–22.30 4–10.30	0–32.60	+15–32.60	04–32.60	6.6–22.30 7.0–10.30	225–32.60
GLEYOSOL	184.57	s-12.03 l-99.23 t-73.31	s-12.03 l–34.43 t–138.11	00–184.57	00–184.57	00–184.57	FM-91.97 SM-92.60	>150–184.57	K1–172.54 00–12.03	00–184.57	6-184.57	0–184.57	-15–12.03 -05–39.47 +05–133.07	1.0–113.78 7.0–58.76 36.0–12.03	7.5–12.03 8.1–172.54	090–12.03 180–19.29 225–15.14 350–79.94 500–58.17
STAGNOSOL	14.18	l–14.18	l–14.18	00–14.18	00–14.18	00–14.18	SM–14.18	>150–14.18	00–14.18	00–14.18	0-14.18	6-14.18	+15–14.18	7.0–14.18	7.5–14.18	225–14.18
ERODOSOL	7.53	u-1.23 l-6.30	u–1.23 l-6.30	15–6.30 34–1.23	00–7.53	00–7.53	SN-1.23 SM-6.30	>150–7.53	K1–6.30 00–1.23	00–6.30 K0–1.23	0–7.53	0–7.53	-05–1.23 +05–6.30	7.0–6.30 36.0–1.23	5.6–1.23 8.1–6.30	045–1.23 090–6.30
TOTAL	368.609	n-1.220 u-37.33 s-910.05 l– 2164.29 t-488.61 a-73.61	n–1.220 u–1.23 s–12.03 l– 1985.05 t– 1155.74 a-519.84	00– 2261.39 11– 992.50 12– 324.67 15–6.30 34–1.23	00–322.214 21–375.38 31–344.3 52–54.14	00–319.1.08 21–188.32 22–306.69	SN-25.03 SP-24.50 SL–34.43 SM– 276.099 SA-95.30 SG–85.83 MM-7.5 FM–387.05 AB–265.42	035–24.50 088–14.61 >150– 364.698	00–224.344 K1–776.51 K2–161.25 K3–64.75 K5–440.14	00–1614.01 K4–95.30 K0– 197.678	0–3130.11 2–22.30 3–324.20 4–24.91 6–184.57	0–2270.92 2-478.04 3-922.95 6-14.18	-15–12.03 -05–438.24 +05– 1384.20 +15– 1395.50 +25–456.12	0.2–93.84 04–831.69 1.0–447.75 7.0–226.285 20.0–24.50 36.0–25.46	5.6–145.18 6.1– 122.8.22 6.6– 125.1.38 7.0–223.59 7.5–77.40 8.1–760.32	045–1.23 090–1300.57 140–1055.42 180–865.95 225–267.75 350–122.39 500–72.78

Tab. 1 - Pedogeographical characteristics of soil types from the agricultural terrains of Ţibucani commune. Codes according to MESP 1986 and SRTS 2003

Soil type	Surface Ha	Texture class Surface Section		Sheet erosion	Gully erosion	Landslides	Parent materials	Depth of rock	Decarbonat ation	Clay elluviation	Gleyzation	Stagno-gelyzation	Total porosity	Permeability	Upper horizon pH	Humus reserve
-	-	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha	code/ha
REGOSOL	409.81	l-136.89 t-265.42 a-7.50	l-136.89 a-272.92	00–7.50 11–136.89 12–265.42	21–375.38 31–34.43	00–34.43 21–68.69 22–306.69	SL–34.43 SM–102.46 MM-7.5 AB–265.42	>150–409.81	K1–402.31 K2–7.5	00–409.81	0-409.81	0-409.81	+05–136.89 +15–272.92	7.0–136.89 04–272.92	7.5–7.5 8.1–402.31	090–402.31 225–7.5
ALUVIOSOL	295.12	l-253.71 t-7.9 a-33.51	l-253.71 a-41.41	00–295.12	00–295.12	00–295.12	FM–295.12	088–14.61 >150–409.81	K1–151.67 K2–143.45	00–295.12	3–280.51 4–14.61	0–295.12	+05–261.61 +15–33.51	7.0–253.71 1.0-7.9 04–33.51	6.6–18.9 7.0–97.05 8.1–179.17	140–143.45 180–7.9 225–129.16 500–14.61
PHAEOZEM	828.63	l-828.63	l-803.15 t-25.48	00–786.18 11–42.45	00–828.63	00–828.63	SM–828.63	>150–828.63	K1–43.69 K3–42.45 K5–440.14 00–302.35	00–526.28 K0–302.35	0-784.94 3-43.69	0-803.15 2-25.48	-05–358.99 +05–444.16 +15–25.48	7.0–828.63	6.1–342.02 6.6–442.92 7.5-43.69	140–276.87 180–440.14 225–69.17 350–42.45
EUTRIC CAMBISOL	159.33	l-17.35 t-141.98	l-17.35 a-141.98	11–159.33	00–159.33	00–39.70 21–119.63	SM–159.33	>150–159.33	00–159.33	00–159.33	0-159.33	0-17.35 3-141.98	-05–1.85 +05–15.5 +15–141.98	7.0–17.35 04–141.98	6.1–143.83 6.6–15.5	090–1.85 140–15.5 180–141.98
PRELUVOSOL	812.88	s-147.98 l-664.90	l-31.244 t-500.44	00–445.37 11–308.26 12–59.25	00–812.88	00–812.88	SM–812.88	>150–812.88	00–812.88	K0–812.88	0-812.88	0-496.99 2-112.84 3-203.05	+05–332.53 +15–327.26 +25–153.09	0.2–93.84 04–59.25 1.0–162.8 7.0–496.99	6.1–351.03 6.6–368.01 7.0–93.84	090–31.244 140–243.8 180–256.64
LUVOSOL	941.44	n-122.0 u-36.10 s-750.04 l-143.10	n-122.0 l-406.60 t-469.41 a-53.23	00–595.87 11–345.57	00–887.30 52–54.14	00–941.44	SN–23.80 SM–744.61 SA–95.30 SG–53.23 SP–24.50	>150–916.50 035–24.50	00–941.44	K4–95.30 K0–846.14	0-941.44	0-23.80 2-339.72 3-577.92	-05–36.70 +05–54.14 -15–12.03 -05–39.47 +05–133.07	04–291.43 1.0–163.27 7.0–45.004 20.0–24.50 36.0–12.20	5.6–143.95 6.1–391.34 6.6–383.75 7.0–22.40	090–565.64 140–375.80

Tab. 1 - Pedogeographical characteristics of soil types from the agricultural terrains of Ţibucani commune. Codes according to MESP 1986 and SRTS 2003

in the central and eastern parts, and the extension of pastures in the west of the territory. The low scale use of mechanical tools in the agricultural works has led to the occurrence of hardpan in soils.

In the territory have been emplaced some perimeters of agrarian improvements, such as drainage works in the Moldova and Umbrari floodplains and a channel to collect the rainfall waters from the reverse of the cuesta.

2. The soil cover

The present soil type distribution has been decisively influenced by the climate, relief and vegetation conditions, whose action over-imposed the existing lithologic conditions. Thus, in the west of the territory, on summits and easily inclined slopes, the soil forming process had a long continuous evolution. On the moderate or strongly inclined slopes the soil formation process has been slowed or interrupted by gravitational processes (erosion or landslides). On these terrains the soils present an incipient evolution stage (Regosols) or are affected by sheet erosion.

Soils with the largest extension in the territory are Luvosols on the high hills from the west, covering 25.54 %, Phaeozems extended on the terraces and lower slopes of the cuesta reverse with 22.48 % and Preluvosols from summits and weakly-moderately inclined slopes, with 22.05 % of the total.

The formation of the soil cover in this territory was done through the action of the soil forming processes such as biological accumulation, clay illuviation, levigation, gleyzation, stagno-gleyzation, swelling processes, erosion, and land-sliding and flooding.

The diversity of soil forming conditions has led to the formation in the territory of a relatively diverse but weakly typologically complex soil cover, with large areas at the level of terraces and cuesta reverse and weakly extended areas and more diverse typologically at the level of the piedmont hills.

According to SRTS–2003, in the surveyed territory have been mapped ten soil types grouped in 7 soil classes.

Protisols are the third class as percentage, and are developed on varied surfaces, positioned in the Moldova and Umbrari floodplains and on slopes, covering 704.93 (19.13 %) of the territory. It includes Regosols and Aluviosols.

– Regosols, with calcaric subtypes, are extended on 409.81 ha, meaning 11.12 %;

– Aluviosols, that may be calcaric, gleyic, molic or vertic, ocuppy the fifth position in the territory, with a surface of 295.12 ha (8.01 %), mainly in Moldova's floodplain.

Chernisols occupy a surface of 828.63 ha, representing 22.48 %, being the second class as extension in the territory, and including as types Phaeozems. Being

the zonal soil of the Moldova corridor, it may have the cambic, argic, greic, gleyic, calcaric or stagnic subtypes.

Cambisols occupy a surface of 159.33 ha (4.32 %), being represented only by Eutric Cambisols, which may be typical or stagnic.

Luvisols are the most extended soil class in the commune, covering 1754.32 ha, meaning 47.59 %, and includes Preluvosols and Luvosols, zonal soils for the piedmont hills from the western part.

Preluvosols, which may be typical, molic or stagnic, are the third type as percentage, being met on summits of average altitude and on weakly-moderately inclined slopes, occupying 812.88 ha (22.05 % of the surface). Luvisols occupy 941.44 ha, representing 25.54 %, being the soil with the largest extension in the territory. At the subtype level they may be in typical, stagnic, litic or albic.

Pelisols are present on 32.60 ha (0.88%), and include gleyic or calcaric Vertosols.

Hydrisols extend on 198.75 ha, meaning 5.39 %. The present soil types are Stagnosols and Gleysols. Stagnosols extend on 14.81 ha, representing 0.38 % of the total. They are met in areas lacking drainage at the level of the summits, in the central and western parts of the territory, and are represented by the typical subtype. Gleysols occupy surfaces of 184.57 ha (5.01 % of the total). These soils are present on the floodplains of Umbrari and Moldova, and at the subtype level are eutric, calcaric or cernic.

Anthrisols include as soil type Erodosols, which maintain at the surface a Bt or Ck horizon. These soils occupy 7.53 ha, meaning 0.20 % of the territory, being at the subtype level argic and calcaric.

Soil texture at the surface is dominantly loamy, followed by the loam-sand and loam-clayey textures, whose percentage reaches about 97 % of the agricultural territory.

Soil reaction in the upper horizon is depending on the soil genetic evolution. On the commune's territory dominate the weakly acid and weakly alkaline soils, calcic amending being needed on 224.8 ha.

Total porosity is characterized on most of the territory as being medium and small (about 72 % of the total surface).

Humus reserve has been calculated on the 0-50 cm depth, according to the humus content, horizon depth, bulk density and skeleton content. In the surveyed territory dominate the classes of low, medium and large humus reserves, with a percentage of over 87 %.

The state of agricultural terrains provision with mobile phosphorous is very low and low on about 85 % of the territory. In what regards the mobile potassium, the provision is medium on 53.38% and well on 29.05 % of the agricultural terrains.

The provision of soils with nitrogen is, according to the CN ratio, that the soils from the Țibucani commune are very weakly provisioned on 14.86 %, medium provisioned on 64.86 % and well provisioned on 20.28 % of the total surface.

3. Risk factors that affect environmental state and terrain productivity

Environmental factors are important both for the population and agriculture. In the surveyed territory the risk factors (limitations) lower the productive capacity of the terrains or limit the living conditions of the population. The presence of these environmental conditions is due both to the action of the physico-geographical factors and to human activity, which affected their state.

Natural limitations are due to reduced available soil volume for the soils formed on gravels, to the presence of sheet erosion on the inclined terrains which leads to a lowering in the humus and nutrient reserves, to the presence of landslides and gullies on the right slope of Umbrari brook and in its upper basin, on moderately-strongly inclined terrains with an intense geomorphic evolution. The area west of Țibucani, due to a change in the access roads, favored an accelerated development of torrential organisms and gullies.

Natural limitations occur also due to the phreatic humidity excess in the Moldova and Umbrari floodplains, which determines the gleyzation of soil horizons. The stagnant water excess is present in the same areas, in the west of the territory, being frequently due to flooding. The flooding risk is amplified on Umbrari valley and by the meadow's natural obstacles which are present because of vegetation or dumps of household waste.

Other limitations are due to inequalities of the terrain in the areas with landslides and gullies, to general compaction of soils caused by clay illuviation and to the defective exploitation of terrains. Problems are present and because of the low humus reserve of less than 120 tons per hectare, of the acid reaction of soils, accentuated by the excessive use of physiologically acid reaction fertilizers. The absence of agrochemical studies in the last 20 years and the chaotic use of fertilizers created an unequal provision with nutrients in soils.

The terrains' productive capacity is also influenced by the fine or coarse texture, which determines difficulties in the plants' use of water.

In the last years, because of the prospecting for natural gases, have been created limitations of the productive capacity through compaction and decopertation, and the re-entering of these terrains in the agricultural circuit does not manage to fully re-establish the soil.

4. Improvement works needed

The presented risk situations may be sometimes improved through works of agricultural improvement, which refer to:

1. dams emplacement and regularization of water courses, needed for the protection of a total surface of 299.35 ha, of which 217.35 ha arable terrains and 82.00 ha pastures;
2. drainage works needed on 753.28 ha, of which 638.11 ha arable terrains and 115.17 ha pastures;
3. superficial drainage needed on 697.24 ha, of which 325.60 ha arable terrains and 371.64 ha pastures;
4. capital drainage and leveling needed on 401.36 ha, of which 32.75 ha arable terrains and 368.61 ha pastures;
5. drainage and pumping needed on 18.78 ha, of which 17.79 ha arable terrains and 0.99 ha pastures;
6. anti-erosional works on 517.44 ha arable terrains;
7. anti-erosional crop systems on 510.07 ha arable terrains;
8. protection plantations / belts on 401.50 ha, of which 32.75 ha arable terrains and 368.75 ha pastures;
9. radical fertilization needed on 1187.89 ha, of which 848.82 ha arable terrains and 339.07 ha pastures;
10. calcic amendments on 194.60 ha arable terrains and 22.55 ha pastures;
11. deep loosening on a surface of 1051.74 ha arable terrains;
12. elimination of rock fragments needed on 21.40 ha arable terrains;
13. terracing, earth waves on 44.74 ha arable terrains;
14. destroying mole hills on 998.58 ha, of which 438.17 ha arable terrains and 560.41 ha pastures;
15. deforesting and removal of stubs needed on 439.52 ha, of which 59.74 ha arable terrains and 379.78 ha pastures;
16. irrigations needed on 1392.68 ha arable terrains;
17. capital leveling needed on 114.62 ha, of which 86.71 ha arable terrains and 27.91 ha pastures;
18. arranging gullies and torrents on a surface of 403.05 ha, of which 80.37 ha arable terrains and 322.68 ha pastures;
19. removal of reed needed on a surface of 16.48 ha, of which 14.82 ha arable terrains and 1.66 ha pastures;
20. applying the best crop practices for agricultural terrains;
21. respecting recommended technologies so as to re-give the agricultural circuit a part of the affected terrains.

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