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# Capture and storage of Carbon dioxid: a method for countering climatic changes

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**Abstract**. One of the options aimed at preventing climatic changes is the capture and storage of carbon dioxide, a method with a great potential for reducing greenhouse gases.
Capturing and storing carbon dioxide in the soil involves new benefits for the communities in the respective areas. Those benefits also follow from the fact that the organic compound has an essential factor in the soil, determining its properties.
The paper presents several results concerning the determination of the quantity of carbon dioxide in different types of soil and it is intended to be the beginning of the process of data collection and the analysis of the reserves and the flow of carbon.

## 1. Introduction

One of the options that aims to prevent climate change is the capture and storage of carbon dioxide, a method with high potential for reducing greenhouse gas emissions.

The main greenhouse gases are water vapor ($H_2O$), carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$) and ozone ($O_3$).

Water vapor is at the origin of 55% of the greenhouse effect. Additional carbon dioxide released by human activity is responsible for 55% of the increase in the greenhouse effect.

Terrestrial ecosystems and oceans absorb much of the $CO_2$ emissions. The majority (2/3) terrestrial carbon is found within the soil surface (soil and roots). The flow of terrestrial carbon or organic carbon in soil and atmosphere is important and can be positive (sequestration) or negative ($CO_2$ emission).

The plants, through photosynthesis, transform $CO_2$ and $H_2O$ in carbohydrates and oxygen:

$$6\ CO_2 + 6\ H_2O + \text{light} \rightarrow C_6H_{12}O_6 + O_2$$

An important consequence of photosynthesis is the release of $O_2$ molecule.

Photosynthesis stops at night, but the plant breathes both day and night. The amount of $CO_2$ resulting in breathing is less important than that of $O_2$ resulting from photosynthesis during the day.

Soil humification process occurs (the process of degradation of organic matter, roots, crop residues, leaves falling) which affords a certain amount of carbon and humus. The quality of the humus obtained depends on the physico-chemical conditions of the soil in question (pH, oxygen content, the content of the base parts, or calcium cation).

There are big differences between arable soils and grassland soils, in terms of their storage capacity for carbon.

Arable crops are recognized by their specificity:

- erosion caused by water and wind
- annual crop rotation and the disturbance a live of soil
- soil compaction by heavy machines (spreading of fertilisers, seeds and harvests)
- Ground work, etc.

For the pasture there are:

- more organic substance (roots)
- period of growth and photosynthesis longer
- permanent coverage
- higher retention water
- presence of ruminants (more emissions of different greenhouse gases), etc.

This paper presents experimental results on the analysis of pedological soil Veţel village, Hunedoara county.

## 2. Experimental part

### *2.1. The geographical framework of the village of Veţel (Hunedoara County)*

Veţel village is located in the central part of Hunedoara county, consisting of the following localities: Veţel - communal residence, Boia Bârzii, Bretelin, Căoi, Herepeia, Leşnic, Mintia, Muncelu Mic, Muncelu Mare, Runcu Mic. The surface of the village is 11389 ha. Veţel village is considered one of the most developed village in the county of Hunedoara [1].

**Geographic** position Veţel the village is limited by values 45° 54' 00" degrees north latitude and 22°48' 00"east longitude.

**Shared access** is on Route 7, which runs through the village. The main watercourse that runs through the territory of the village is the Mureș river. The administrative territory of the village Veţel id bordered to the North by the Mureș river and Ilia, Brănișca and Șoimuș, to the west is bordered by the communes of Ilia, Dobra, and to the south with the municipalities of Peştiş, Cerbăl and to the east of the village Cârjiți and the town Deva.

**The relief** is varied and fall in Poiana Rusca massif consisting of crystalline schists with a complex geological structure and fragmentation pronounced. In terms of topography Veţel village is uneven, showing different levels of elevation 179.80 MN (Mures meadow in the locality Leşnic) to share the locality 780,00 MN Muncelu Mare. The vegetation is characterized predominantly hilly forests of beech, hornbeam and oak and grassland. Soils fall within the brown forest, sylvan podzolic and brown-yellowish.

**Hydrology**

The hydrographic network of the Mures river gathers all the waters flowing in the area. The valleys are mostly narrow and deep with active slope processes. At the bottom of the basin lands appear moderate and strong land erosion.

**Geotechnical characteristics**

From the survey shall be recorded in the area following stratification:

a) Shares between the land surface and considered to ± 0.00 - 0.50 topsoil
b) Among shares - 0.50 - 2.50 with alternate gray brown clay with calcareous concretions viscous plastic - land shrinkable
c) Under elbow - 2.50 appears the rock, appearing isolated layers of gravel and sand
d) Groundwater appears steady to share - 3.0 m
e) The minimum depth of the foundation is - 1.0 m
f) Allowable pressure of 200 kPa or 2.0 kgf / cm²

**Land use**

Veţel village covers an area of 11389 hectares, representing about 2% of the county of Hunedoara. In this area included:

a) 4085 ha - agricultural land accounting for 35.86% of the commune, of which: 1264 hectares of arable land 1520 ha pastures, hayfields 1298 ha and 3 ha of orchards

b) 6647 ha - forestry fund, respectively 58.36% of the area of the commune
c) 657 ha - non-agricultural lands occupied by courtyards, buildings, roads, unproductive lands, waters and reed.

### *2.2. Soil characterization*

To characterize the soil of Veţel commune, they were determined following indicators:

- *pH* (Potentiometric method). It is determined in aqueous solution or brine, in various ratios of soil extract to water. The current method for determining the potentiometric pH is in aqueous solution with a ratio of soil: water of 1: 2.5. [3]
- *Determination of carbonate anion* from the aqueous extract, [3]
- *Hydrolytic acidity, Ah* (Kappen method). [3]
- *Determination of base cation exchange, SB* (Kappen method). [3]
- *The degree of saturation in bases VAH*. It is calculates by formula:

$$Vah\ [\%] = SB / (SB + Ah) \times 100 \quad (1)$$

where,
B - amount of exchangeable cations [me / 100 g soil]
Ah - hydrolytic acidity [me / 100 g soil]

- *Cation Exchange Capacity T.* It is given by formula*:*

$$T\ [me / 100\ g\ soil] = SB + Ah \quad (2)$$

where,
SB - The amount of exchangeable cations [me / 100 g soil]
Ah - hydrolytic acidity [me / 100 g soil]

- *Index nitrogen,* IN. It is given by*:*

$$IN = H \times VAH / 100 \quad (3)$$

where,
VAH - base saturation level
H% humus

- *Determination of soil organic carbon and humus content estimation* (Wet oxidation method and dosage titration Walkley-Black).[3]
- *Determination of phosphorus in cell extract sodium bicarbonate* (Olsen method). [4]

Samples must be taken from different depths. For arable soil, they must saddle be at 20, 40, 60 and 100 cm, and grass soils: 10, 20, 50 and 100 cm. The highest concentration of C is found in the first 15 centimeters of soil.

It is possible to calculate C from organic matter (MOC) of the soil on the basis of an exponential curve [2], [5]:

$$C_z = C_b + (C_0 - C_b)\cdot e^{-kz}\ (1) \quad (4)$$

where: Cz= Density C (g MOC·cm-3soil) at depth z
$C_0$ C = density at a depth 0
$C_b$ C = density of the depth b
k = constant expressing exponential decrease of C with depth

The density should be calculated: % C (g MOC·$g^{-1}$soil) x density of soil $\square_d$(G soil·$cm^{-3}$).

In the context of the fight against climate change and the Kyoto protocol, an important issue is represented by the creation of reserves of carbon important and quantifiable in agricultural soils from around the world.

According to data from the literature [5-8], [10], the calculation of the reserves of carbon stocks, by origin and the type of soil, to a depth of 1 meter is realized in the following way:

- General average: 30 - 120 t C $ha^{-1}$;
- Arable crops in a year: 43 t C $ha^{-1}$ (varying between 35 and 55 t C $ha^{-1}$);
- Grapevine: 32 t C $ha^{-1}$ (25-42 t C $ha^{-1}$ ) ;
- Soils abandoned: 45 t C $ha^{-1}$ (32-58 t C $ha^{-1}$ ) ;
- Permanent grassland and forests: 70 t C $ha^{-1}$ (54-88 t C $ha^{-1}$);

- Meadows of altitude and swamps: 100 t C $ha^{-1}$ (87 -115 t C $ha^{-1}$) (low temperature - lack of oxygen);
- Sandy soils: 30 t C $ha^{-1}$;
- Clay soils: 120 t C $ha^{-1}$ ;

## 3. Results and discussions

To characterize the soil Veţel, they took samples of more than 500 points, different profile and at different depths. Some of the results are shown in Table 1.

Agricultural development over time has led to consumption of land carbon stocks. As bulk of cultivated soils, there is a reduction in productivity. This can be changed by changing the type of agriculture practiced.

Guo and Gifford [7] conducted a study in 2002 calculated the effect of different substances used in soil on the concentration of carbon in the soil. From this study it follows that it loses much C through the conversion of grassland or forests into arable land, and on the other hand, it wins much C by the transformation of the surface soil in forests or meadows.

Arable soils are sources of $CO_2$.

The meadows are reserves of $CO_2$.

Kyoto Protocol and facilities for carbon sequestration in the soil are good opportunities for achieving this goal. Soils may retain carbon emissions, providing benefits to soil quality, crop and environment, in order to prevent erosion and to add value to biodiversity.

Farmland and pastures have the potential for soil carbon sequestration, provided that the crop be able to increase carbon accumulation and productivity.

Carbon sequestration involves the possibility of a double-win solutions [5], and new benefits for local communities. Attention should be drawn to the governmental authorities on the potential benefits and the need of initiating a process of data collection and analysis of carbon flux and reserves, carefully chosen from different sites at a given scale.

These benefits result by the fact that organic substance is a key factor in soil, which determines a multitude of properties or functions property related soil to buffer the effect of sustainability.

In Veţel, agricultural land represents 35.86% of the area (11.1% is arable and 24.7% pasture and hayfield). The humus content of the soil Veţel village is small and decreases with increasing soil depth. At depths greater than 50 cm is not found in soil humus.

Not all samples are ground carbonates. In samples containing carbonates can be seen that the content increases with increasing depth of sampling.

The phosphorus content in the soil could be found at shallow depths; 40-50 cm phosphorus is not found.

Nitrogen is present in small quantities and on small areas.

Cation exchange capacity is between 16.47 and 28.11.

## 4. Conclusion

The most important source of raw material is the soil organic plant material submitted annually, the material is only partially decomposed fallen recently.

The organic substance plays an essential role in soil, causing its properties have a buffer effect on sustainability. Basically, that contribute organic matter to soil fertility is humus (organic matter stable) is a form of carbon that recalcitrant to biodegradation, with stability in soil ranging between 50 and 2000 years.

Long-term evolution of the stock of humus in the soil is subject to two fundamental categories of processes: processes of humidifying, mineralization and erosion processes. They act conjugate at the top of the soil, resulting in a progressive, regressive or reserve humus complex.

**Table 1.** Indicators of soil samples from the village Veţel

| Profile | Depth [Cm] | pH | H | P | SB | Ah | N | T | V | carbonates |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 8-36 | 5.50 | 1.46 | 29 | 11.48 | 9.39 | 1.56 | 20.87 | 55 | - |
| | 50-110 | 7.26 | 1.25 | - | 19.50 | 4.87 | 0.02 | 24.37 | 80 | - |
| 24 | 8-23 | 5.30 | 1.35 | 29 | 10.90 | 8.44 | 1.78 | 19.00 | 56 | - |
| | 24-48 | 5.66 | 1.19 | 22 | 11.48 | 9.39 | 1.20 | 20.87 | 55 | - |
| | 60-100 | 5.13 | - | - | 11.64 | 8.08 | 1.52 | 19.7 | 59 | - |
| 32 | 7-20 | 4.97 | 1.88 | 29 | 10.40 | 7.70 | 1.55 | 28:10 | 37 | - |
| | 40-110 | 5.46 | 1.59 | - | 10.90 | 6.43 | 1.83 | 16.47 | 60 | - |
| 38 | 7-34 | 6.10 | 1.45 | 26 | 14.80 | 6.96 | - | 21.76 | 68 | - |
| | 50-100 | 5.97 | 1.36 | - | 14.28 | 7.78 | - | 22.06 | 65 | - |
| 62 | 8-34 | 6.30 | 1.57 | 6 | 13.56 | 6.23 | - | 19.79 | 68 | - |
| | 50-100 | 6.08 | 1.29 | - | 13.96 | 6.56 | - | 20.52 | 68 | - |
| 116 | 8-32 | 5.60 | 1.58 | 10 | 14.28 | 7.78 | - | 22.06 | 65 | - |
| | 50-64 | 6.15 | 1.39 | - | 13.96 | 6.50 | - | 20.52 | 68 | - |
| | 64-84 | 6.22 | - | - | 18.64 | 8.37 | - | 27.01 | 69 | - |
| 149 | 7-26 | 8.46 | 1.36 | 60 | - | - | - | - | 90 | 2.40 |
| | 40-100 | 9.26 | - | - | - | - | - | - | - | 4.85 |
| 239 | 7-45 | 6.61 | 1.42 | 6 | 13.56 | 5.81 | - | 19.37 | 70 | - |
| | 60-90 | 6.26 | - | - | 19.00 | 8.15 | - | 27.15 | 69 | - |
| | 100-120 | 6.10 | - | - | 16.40 | 8.83 | - | 25.23 | 65 | - |
| 248 | 7-26 | 5.17 | 1.13 | 8 | 19.36 | 8.75 | - | 28.11 | 68 | - |
| | 37-50 | 5.23 | 1.08 | 16 | 13.08 | 10.00 | - | 23.08 | 56 | - |
| 283 | 8-20 | 5.70 | 1.83 | 7 | 19.36 | 8.75 | - | 28.11 | 68 | - |
| | 40-67 | 5.74 | 1.6 | - | 14.02 | 6.29 | - | 20.31 | 69 | - |
| | 67-80 | 5.60 | - | - | 16.44 | 10.52 | - | 26.96 | 61 | - |
| 336 | 7-40 | 8.43 | 1.48 | 24 | - | - | - | - | 83 | 1.25 |
| | 40-72 | 8.60 | 1.15 | - | - | - | - | - | - | 1.30 |
| | 82-130 | 8.75 | 1.28 | - | - | - | - | - | - | 1.40 |
| 350 | 7-24 | 8.20 | 1.15 | 34 | 25.2 | 3.76 | - | 28.96 | 87 | 2.47 |
| | 40-100 | 8.63 | - | - | 28.1 | 3.47 | - | 31.57 | 89 | 2.55 |
| | 110-120 | 8.20 | - | - | 26.8 | 3.65 | - | 30,45 | 88 | 2.40 |
| 396 | 7-34 | 9.65 | 1.42 | 54 | - | - | - | - | - | 4.87 |
| | 45-110 | 9.22 | - | - | - | - | - | - | - | 4.20 |
| 414 | 0-22 | 7.55 | 1.63 | 124 | 19.2 | 4.67 | - | 23.87 | 80 | - |
| | 22-38 | 7.40 | 1.22 | 120 | 17.56 | 4.40 | - | 21.96 | 79 | - |
| | 50-80 | 7.45 | - | - | 19.60 | 3.82 | - | 23:42 | 83 | - |
| 431 | 7-24 | 7.80 | 1.53 | 26 | 16.80 | 3.86 | - | 20,66 | 81 | 0.7 |
| | 34-105 | 7.68 | 1.17 | - | 19,20 | 4.67 | - | 23.87 | 80 | 0.55 |
| | 115-130 | 8.36 | - | - | 19.60 | 3.82 | - | 23:42 | 83 | 1.04 |
| 455 | 7-42 | 5.53 | 1.20 | 18 | 19.02 | 8.79 | 1.34 | 27.81 | 68 | - |
| | 52-110 | 5.70 | - | - | 12.20 | 10.63 | 1.46 | 22.83 | 54 | - |
| 503 | 7-38 | 8.32 | 1.46 | 34 | - | - | - | - | 85 | 0.10 |
| | 48-98 | 8.64 | - | - | - | - | - | - | - | 0.10 |
| 524 | 0-22 | 9.76 | 1.38 | 44 | - | - | - | - | 93 | 4.30 |
| | 22-44 | 9.64 | 1.25 | 56 | - | - | - | - | - | 4.52 |
| | 55-100 | 9.86 | - | - | - | - | - | - | - | 5.13 |

Degraded lands are lands that, due to the action of human activities (farming and forestry inappropriate, potentially toxic elements pollution) or natural (erosion under the influence of climatic factors) lost organic matter.

The accumulation of soil organic matter is beneficial both for crop production and for the fixation of carbon dioxide and reducing the impact of his action as a result of greenhouse gas. In this regard it has been developed a number of mechanisms by which governments, regional institutions and international organizations (such as the World Bank) provides financial support for measures to net carbon accumulation in the soil.

Carbon sequestration involves the possibility of a double-win solutions and new benefits for local communities. Therefore it is necessary to initiate a process of data collection and analysis of reserves and carbon flux at the national level.

Lack of knowledge and data on national practices regarding quantitative analysis related to the measurement and interpretation of field data, generate problems in terms of assessing the carbon flux.

Total deposit of carbon present in the grasslands ecosystem is far lower than in some forest ecosystems located in the basement but the higher meadows. Generally the carbon content of the soil of pastures is much higher compared to other crops.

Veţel village has 24.7% of the area occupied by pastures and hayfields and 58.36 forestry fund. Cropland, grassland and forests in the village Veţel have potential for soil carbon sequestration, which generates reducing the amount of greenhouse gases and increase productivity.

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