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RESEARCH ON THE INFLUENCE OF FLOODS ON THE PHYSICAL CHARACTERISTICS OF SOIL

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ABSTRACT

The paper presents research on the influence of floods in the hydrographic basin of Siret River, on the soil. Soil moisture and porosity were determined to observe the influence of excess water in the floodplain area, where the soil is marshy, on the possible deterioration of soil properties, and possible landslides in the Siret riverbank area.

KEYWORDS: soil, humidity, porosity

1. Introduction

Floods are potentially very destructive events that occur when land surfaces are covered with a significant amount of water. They negatively impact the quality of life, through material damage and human casualties.

The trend of flooding is becoming more and more prevalent due to changing climatic conditions due to pollution and massive deforestation.

The main physical characteristics of the soil are: soil texture, soil structure, soil density, soil porosity, degree of subsidence, soil compaction, resistance to soil works, soil plasticity, soil swelling and contraction, adhesion and external friction, cohesion and internal friction [1, 3].

2. Experimental research on soil humidity and porosity in a flood-prone area

Soil moisture and porosity were determined on soil samples taken from the Movileni floodplain, in the hydrographic basin of Siret River. Soil samples were taken according to the requirements of STAS 17.4.4.02-84 "Nature protection. Soils. Methods of collection and preparation of samples for chemical, bacteriological and helminthological analysis", as well as STAS 28168-89 "Soils. Sample collection" [2]. The samples were taken from different depths of 10, 20 and 30 cm, respectively from a high flood risk area in the Siret River basin, Movileni village.

The soil was collected in hermetically sealed containers, so that water would not evaporate during transport, and the samples were kept in the refrigerator for no more than 24 hours [4].

3. Determination of soil moisture by gravimetric method

To determine soil moisture, the gravimetric method was used. The soil samples were dried at 105 °C in an oven until constant weight was reached and then each sample was weighed. The difference in weight obtained before and after drying represents the moisture content, which is expressed as a percentage.

The weighing was done on an analytical balance (Fig. 1).

Fig. 1. *Weighing the soil sample*

The weighing vial is placed uncovered, together with its lid, in an oven at a temperature of 105 °C, for 2 hours (Fig. 2).

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Fig. 2. *The oven used in the experimentation*

The sample is kept for 15 minutes, after which it is left to cool in a desiccator, with calcium chloride, for 30 min. It is then weighed on an analytical balance. The operation is repeated until the difference between two successive weightings is no greater than 0.0002 g (in most cases two dryings were sufficient).

In the weighing vial brought to constant weight, approximately 50 g of soil prepared for analysis were immediately introduced, after which it was weighed on an analytical balance. The difference from the weight of the empty weighed vial represents the mass of the soil taken for the determination of hygroscopic humidity. The weighing vial with the soil sample is placed uncovered, together with its lid, in the electric oven at a temperature of 105 ºC, and kept for 2 hours.

The drying operation is repeated by keeping the soil sample in the oven at a temperature of 105 ºC, until the difference between the last two successive weighing is less than 0.0002 g, i.e. the mass remains practically constant. All manipulations with the weighing vial are done with the help of laboratory pliers, to avoid the adhesion of impurities from the fingers on the walls of the vial.

The formula used to calculate soil moisture is:

$$U\ [\%] = (M\ water)/(M\ soil)\ X\ 100$$

where: M soil = soil mass after drying for one hour at 105 °C;

M water = M soil with water - M dry soil

To calculate the moisture content of the 3 soil samples, we weighed 50 g of soil before drying in the oven. After several successive weighing, when the soil mass remained constant, the moisture content was calculated.

The data obtained from calculating the humidity of the 3 samples were centralized in Table 1.

Table 1. *Values for humidity*

Sample	**Soil before drying [g]**	**Soil after drying [g]**	**Humidity [%]**
P 1 (collected from 10 cm depth)	50	41.936	83.87
P 2 (collected from 20 cm depth)	50	41.745	83.49
P 3 (collected from 30 cm depth)	50	41.734	83.46

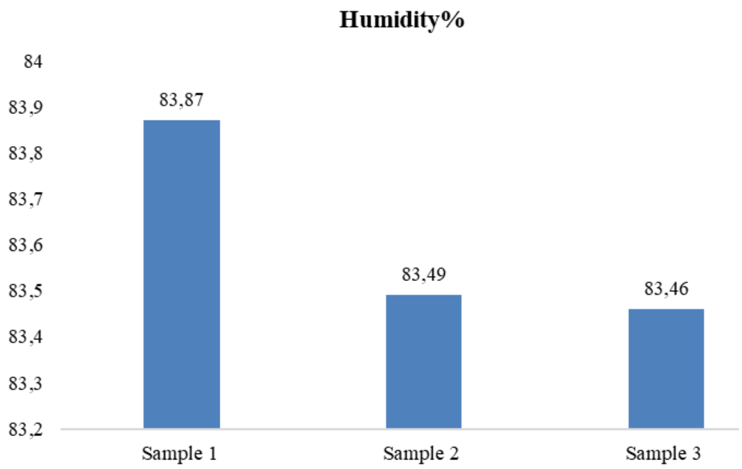

Fig. 3. *Humidity of soil samples*

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The graphic in Fig. 3 illustrates the values obtained for moisture for the three soil samples.

From the calculation of humidity and the graph we can say that at sample 1 (harvested from 10 cm), the highest humidity was obtained, because this soil was a swampy soil, saturated with water.

At sample 2 (harvested from a depth of 20 cm), the humidity is much lower and in sample 3 (harvested from 30 cm) depth, the humidity is very close to sample 2 with small decreases in humidity values.

4. The determination of soil porosity

For uncultivated soil, porosity values decrease with the depth of the sampling layer. The area from which we collected the samples is an uncultivated and floodable area.

Soil density depends on: the mineralogical composition, respectively the humus content and provides data on: the composition of the soil, the proportion between the mineral and organic part, the calculation of porosity and the determination of the granulometric composition of the soil.

Generally, a good porosity is considered to be that which allows the continuous circulation of air and water in the soil. Such porosity appears in soil horizons with a granular/glomerular structure, loose, rich in organic matter, with a clayey texture and characterized by intense biological activity. Within these horizons, porosity is stable, being weakly influenced by variations in the humidity regime, reaching values of 50-60% [5, 6].

Porosity is unfavourable in clayey or unstructured horizons, with high clay content, in which the pore spaces decrease greatly with increasing humidity. In these horizons, water stagnates, the soil not being aerated.

Porosity influences:

- the dynamics of gas exchange between the soil and the atmosphere;
- the quantitative and qualitative functionality of rivers and groundwater;
- it determines the recharge of the groundwater, the flow regime of rivers, and also influences their chemical composition;
- triggering of surface erosion;
- plant development.

To determine the porosity, 50 g of compacted soil, which I had previously prepared by crushing, was weighed on an analytical balance. After weighing and preparation, I introduced the soil sample into a 100 mL graduated cylinder (Fig. 4.).

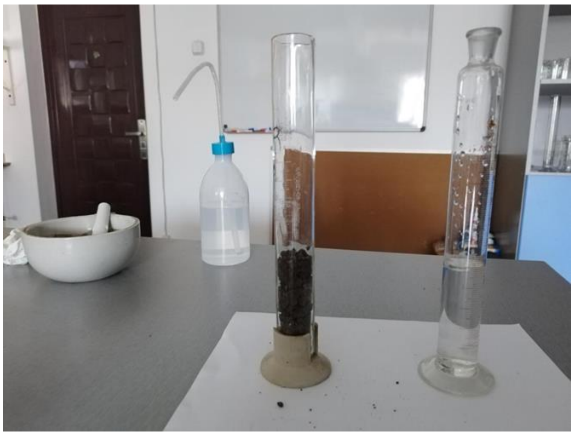

Fig. 4. *Graduated cylinder with soil sample*

Part of the added water infiltrates into the soil, filling its pores and displacing the respective air. The volume occupied by the soil together with water is read on the cylinder. The number of mL that constitutes the difference between 100 and the volume occupied by the soil together with water represents the pore volume.

The water and soil samples are left for 24 hours after which the pore volume is read and calculated (Fig. 5).

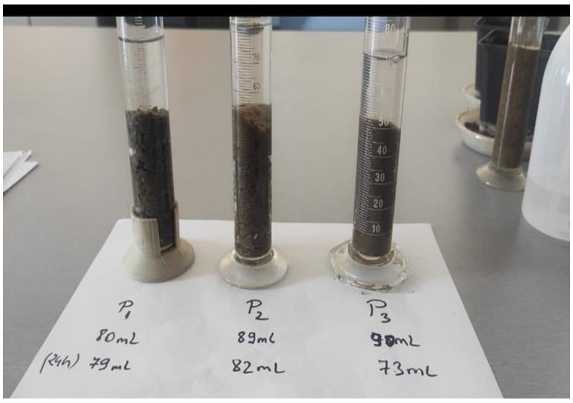

Fig. 5. *Pore volume, reading after 24 hours*

Calculation of porosity of soil samples:

Pore volume = 100 - Vt (water + soil)

For sample P1 collected from a depth of 10 cm (boggy soil):

P1: 50 g soil + 50 mL water

The volume of soil and water read immediately after inserting the sample into the cylinder is = 80 mL

Vt water + soil = 80 mL

V pores = 100 - 80 = 20 mL (air)

After 24 hours we calculated the porosity of sample P1:

Porosity (P1) after 24 h = ((100 - 79) · 100)/50= 21 · 2 = 42%

For sample P2 collected from a depth of 20 cm (wet soil):

P2 50 g soil + 50 mL water

The volume of soil and water read immediately after inserting the sample into the cylinder is = 89 mL

Vt water + soil = 89 mL

V pores = 100 - 89 = 11 mL (air)

After 24 hours we calculated the porosity of sample P2:

Vt water + soil = 82 mL

Porosity (P2) after 24 h = ((100 - 82) · 100)/50 = 18 · 2 = 36%

For sample P3 collected from a depth of 30 cm (wet-dry soil):

P3 50 g soil + 50 mL water

The volume of soil and water read immediately after inserting the sample into the cylinder is = 90 mL

Vt water + soil = 90 mL

V pores = 100 - 90 = 10 mL (air)

After 24 hours we calculated the porosity of sample P3:

Vt water + soil = 73 mL

Porosity (P3) = ((100 - 73) · 100)/50 = 25 · 2 = 54%

The data obtained from the porosity determinations are summarized in Fig. 6.

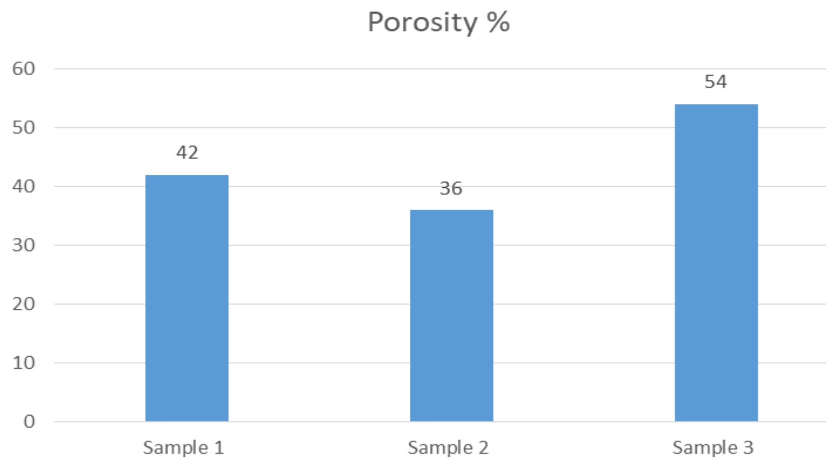

Fig. 6. *Humidity of soil samples*

5. Conclusions

Floods negatively influence the quality of life through material damage and human casualties. Due to climate change, the rainfall and hydrological levels of rivers have changed, increasing the risk of flooding, especially in the downstream areas of the river basins.

The determination of soil moisture and porosity was aimed at seeing how excess water from a floodplain area, where we had a swampy soil, influences some physical characteristics of the soil and its possible damage that can lead to landslides in the area.

Following the moisture determinations, at the sample collected from a depth of 10 cm, the highest moisture was obtained, because this soil was a swampy soil, saturated with water.

In the sample collected from a depth of 20 cm, the humidity is much lower and, in the sample, collected from a depth of 30 cm, the humidity is very close to sample 2 with small decreases in humidity values.

Regarding porosity, in the sample collected from 30 cm, we obtained the highest value, because at this depth the water did not fill the volume of the pores in the soil.

In the sample collected from a depth of 20 cm, the porosity is lower than in the sample collected from a depth of 10 cm, because the water infiltrated and occupied the volume of the pores.

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