# PROPERTIES OF ERODED CHERNOZEMS AND VEGETATION AS A FACTOR OF PROTECTING SOILS FROM EROSION

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**Abstract**

Erosion of soils leads to a decrease in the thickness of the humus horizon, to a decrease in the water permeability and moisture capacity of soils, the content of waterproof aggregates, humus, mobile phosphorus and exchangeable potassium. An example of the negative effect of erosion on soil properties is presented in Table. 1.1. At the same time, soil density, surface water run-off and soil washing are increasing. All this leads to a shortage of crops harvested and a decrease in the efficiency of agricultural production. Figures give a clear idea of the effect of soil erosion on yield reduction in the main crops in conditions of chernozems. These data, based on the synthesis and analysis of numerous experimental data strongly suggest that soil erosion causes the national economy of a huge economic and environmental damage and undermines the very foundation of effective agricultural production. Protection of soils and their protection from erosion - a problem of national importance, which must be under the effective control of the appropriate government agencies. The nature of the influence of vegetation on the properties of the soil gives a visual representation of the depth of penetration of the roots. The loosening effect of the root system of plants on the soil is well known. Consideration of the influence of vegetation on the sink of melt water and the washing away of soil from the slopes is of scientific and practical interest. In the most general form, the nature of this influence is well known. At the same time, the quantitative assessment of flow control and soil conservation efficiency of vegetation is given schematically as separate scientific reports.

**Key words**: eroded chernozems, soil protection, vegetation efficiency, Republic of Moldova

Protection of soils from erosion should be carried out in the direction of maximizing the productivity of agricultural land. The tasks of protecting land and increasing their productivity are inseparable. Thus, soil protection should be carried out in conditions of maximum intensification of agricultural production. And the more intensively the lands are used, the more reliable and qualitative it is to implement complexes of anti-erosion measures. Soil protection is effective only when it is carried out systematically (Caine Nel, 1976). Anti-erosion measures should cover all areas (arable land, orchards, hayfields, pastures and others).

When designing anti-erosion measures, the following main requirements for combating soil erosion should be provided:

- in zones of water erosion - regulation of the runoff of thawed and storm water, creation of a waterproof soil surface;

- in areas of wind erosion - the creation of a wind-resistant soil surface, a decrease in wind speed in the surface layer and a reduction in the size of the dust-collecting areas. Particular attention should be paid to improving the erosion resistance of the soil and its protection by plants or their remains (wings, stubble, etc.).

The landlord strengthens the agro-ecosystems in the stable, in the productive sophistication of the many years. Among the irregularities, the unproductive actions lead to degradations of the agrarian and agro-landscapes in the whole. A further increase in the number of land-based types of land use, and degradation could lead to negative impacts on biofuels throughout the world. The cause of degradation in agro-ecosystems is to deal with the destruction of soil or soil. If soil erosion occurs under the action of water, it is called water erosion, and if under the influence of wind, then wind erosion. When choosing those or other anti-erosion measures, the natural conditions of the design zone, the features of agriculture, the best practices of farms and the recommendations of zonal research institutions are carefully taken into account (Wischmeier W.H. *et al.*, 1965; Мирцхулава Ц.Е., 1975).

The basic principles of land protection can be summarized as follows.

1. Prevention of the possibility of erosion. The main task is to prevent the occurrence of

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accelerated erosion. Consequently, the system of measures for land use and prevention of erosion should be preventive in nature. It is important to emphasize this because until now the planning of land protection works was carried out not on the basis of the registration of lands that need to prevent erosion, but according to the land register of already eroded (destroyed) soils. It is necessary to protect not only the "affected" soils, but also those who are endangered by this danger.

To prevent erosion is, therefore, to prevent a soil-destroying runoff of thawed and rainwater and wind. In cases where full flow retention is impossible or impractical (in an area with excessive moisture), the task is to regulate the flow of water; in zones of wind erosion - in decreasing wind speed. Prevention of erosion can be achieved by increasing water permeability and moisture capacity of soils; creation on the surface of a slope of anti-erosion meso-, micro- and nano- forms of the relief, preventing flow or safely diverting the runoff; use of vegetation and other means to intercept part of surface runoff, dispersal of flows and, consequently, decrease in their eroding capacity (Caine Nel, 1976; Иванов В.Д., 1985).

Erosion of soils causes great damage to the national economy of the country and, first of all, to land resources: the fertility of soils is reduced and the areas of cultivated land are reduced. In zones of wind erosion, a complex of anti-erosion measures should cover the entire area of erosion (a group of interrelated farms or administrative districts).

As shown by numerous observations and experiments, the vegetation cover can reduce or completely prevent the development of water and wind erosion. The relationship here is direct the better the vegetation cover is developed and the higher the soil cover, the weaker the erosion processes.

Moreover, the protection of the soil is borne by the above-ground, that and underground plant organs. The vegetative mass, mainly leaves, protects the soil from the destructive power of raindrops. Root systems of plants bind soil particles, thereby preventing erosion and washing away of the soil (Рожков А.Г. *et al*., 1973).

The ability of plants to protect soil from erosion is expressed by the coefficient of erosion hazard under different crops and under steam (a field not occupied by plants). Perennial grasses with good grass cover the soil throughout the year, but the degree of coverage in autumn, winter and spring is low. Winter cereals cover the soil for 9-11 months (depending on the natural zone) the maximum coverage is in May-July. Spring crops protect the soil only for 3 months, and tilled crops - 1-1.5 months (Иванов В.Д. *et al*., 1990; Косцов Г.В., 1971; Мирцхулава Ц.Е., 1975).

## MATERIAL AND METHOD

The purpose and objectives of the research consisted in studying the current state of eroded chernozems and, using the example of key areas located on the territory of Republic of Moldova, to define a system of indicators characterizing the level of their fertility.

Protected positions:

- a system of basic indicators (particle size distribution, humus reserves in horizons (A + B), degree of saturation of soils with bases, integral correction factor for individual soil properties) to characterize the fertility level of eroded soils;
- functional relationships between crop yields of crops grown with an integrated assessment index of soil properties applied to specific fields and crop rotations, allowing them to be used in determining the volume of crop production.

The practical importance of research consists in a comprehensive assessment of soil properties and their fertility level, in providing forecast calculations of yields and gross collections of crop production, and in the development of a classification of the fertility of eroded soils.

## RESULTS AND DISCUSSIONS

An example of the negative effect of erosion on soil properties is presented in Table 1. Erosion of soils leads to a decrease in the thickness of the humus horizon, to a decrease in the water permeability and moisture capacity of soils, the content of waterproof aggregates, humus, mobile phosphorus and exchangeable potassium. At the same time, soil density, surface water run-off and soil washing are increasing. All this leads to a shortage of crops harvested and a decrease in the efficiency of agricultural production (*Table 2*).

The given data, based on the generalization and analysis of numerous experimental materials, convincingly show that erosion of soils causes' huge economic and ecological damage to the economy undermines the very basis of effective agricultural production. Protecting soils and protecting them from erosion is a problem of national importance, which must be effectively controlled by the relevant government agencies.

The nature of the influence of vegetation on the properties of the soil gives a visual representation of the depth of penetration of the roots (*Figure 1*). The loosening effect of the root system of plants on the soil is well known.

Table 1

**Change in the properties of chernozems from the degree of their erosion on the Republic,%**

| Indicators of soil properties | Erosion of soils, % | Number of samples | Average value | Accuracy of medium |
|---|---|---|---|---|
| 1. Water permeability | unwashed – 100 | 73 | 100 | 1,6 |
| | weakly – 87.5 | 44 | 73 | 1.9 |
| | medium – 62.5 | 46 | 55 | 3.4 |
| | strongly – 37.5 | 26 | 48 | 5.6 |
| 2. Moisture capacity | unwashed – 100 | 33 | 100 | 1.3 |
| | weakly – 87.5 | 18 | 86 | 1.5 |
| | medium – 62.5 | 18 | 76 | 3.2 |
| | strongly – 37.5 | 17 | 61 | 7.4 |
| 3. Waterproof aggregates | unwashed – 100 | 52 | 100 | 4.5 |
| | weakly – 87.5 | 28 | 79 | 5.7 |
| | medium – 62.5 | 29 | 71 | 3.8 |
| | strongly – 37.5 | 24 | 50 | 7.1 |
| 4. Density | unwashed – 100 | 49 | 100 | 1.8 |
| | weakly – 87.5 | 28 | 104 | 2.1 |
| | medium – 62.5 | 29 | 109 | 2.5 |
| | strongly – 37.5 | 21 | 110 | 4.0 |
| 5. Water flow | unwashed – 100 | 34 | 100 | 5.1 |
| | weakly – 87.5 | 17 | 142 | 6.6 |
| | medium – 62.5 | 17 | 152 | 7.2 |
| | strongly – 37.5 | 17 | 170 | 7.4 |
| 6. Soil washing | unwashed – 100 | 249 | 100 | 2.5 |
| | weakly – 87.5 | 127 | 118 | 3.4 |
| | medium – 62.5 | 127 | 147 | 3.4 |
| | strongly – 37.5 | 123 | 178 | 6.7 |
| 7. Humus content in the plow layer | unwashed – 100 | 357 | 100 | 0.5 |
| | weakly – 87.5 | 179 | 76 | 0.8 |
| | medium – 62.5 | 182 | 61 | 1.2 |
| | strongly – 37.5 | 176 | 41 | 2.4 |
| 8. The content of mobile phosphorus | unwashed – 100 | 427 | 100 | 0.6 |
| | weakly – 87.5 | 375 | 73 | 0.9 |
| | medium – 62.5 | 36 | 66 | 1.5 |
| | strongly – 37.5 | 11 | 57 | 3.5 |
| 9. The content of exchangeable potassium | unwashed – 100 | 427 | 100 | 0.7 |
| | weakly – 87.5 | 375 | 75 | 1.0 |
| | medium – 62.5 | 36 | 57 | 1.8 |
| | strongly – 37.5 | 11 | 48 | 4.2 |

Table 2

**Yields of crops on chernozem varying degrees of erosion on the Republic, %**

| Cultures | Unwashed | Slightly washed | Medium washed | Strongly washed |
|---|---|---|---|---|
| Winter wheat | 100 | 73 | 63 | 47 |
| Spring wheat | 100 | 79 | 62 | 48 |
| Barley | 100 | 83 | 70 | 50 |
| Winter rye | 100 | 83 | 63 | 60 |
| Peas | 100 | 93 | 83 | 55 |
| Buckwheat | 100 | 29 | 19 | 7 |
| Oats | 100 | 85 | 71 | 54 |
| Millet | 100 | 62 | 37 | 22 |
| Sunflower | 100 | 85 | 63 | 31 |
| Maize for grain | 100 | 84 | 66 | 50 |
| Maize for silo | 100 | 81 | 62 | 48 |
| Sugar beet | 100 | 71 | 54 | 25 |
| Potatoes | 100 | 71 | 44 | 21 |
| Fodder grass (hay) | 100 | 89 | 80 | 70 |
| For all crops | 100 | 76 | 60 | 42 |

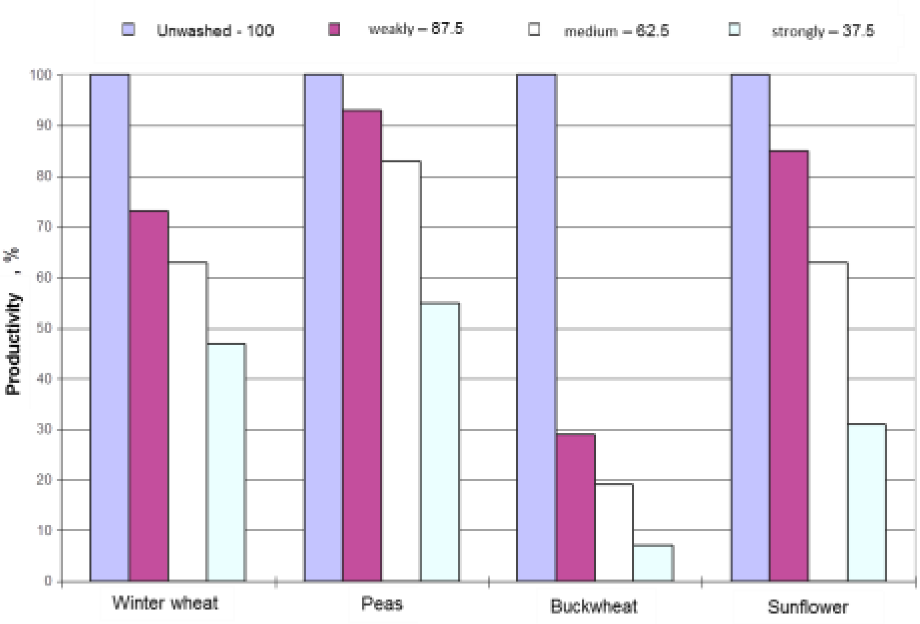


Figure 1 **Influence of the degree of washout of chernozems, on productivity of agricultural crops,%**

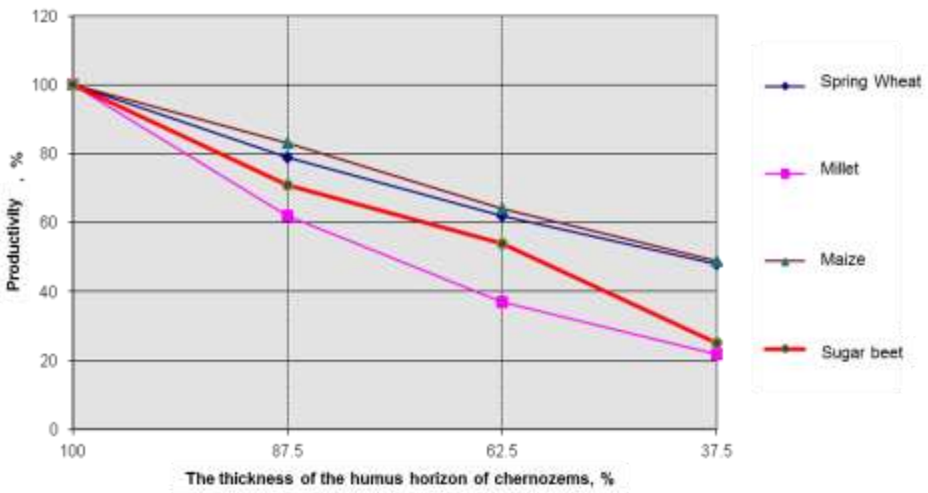


Figure 2 **Dependence of yields of agricultural crops on the thickness of the humus horizon of chernozems**

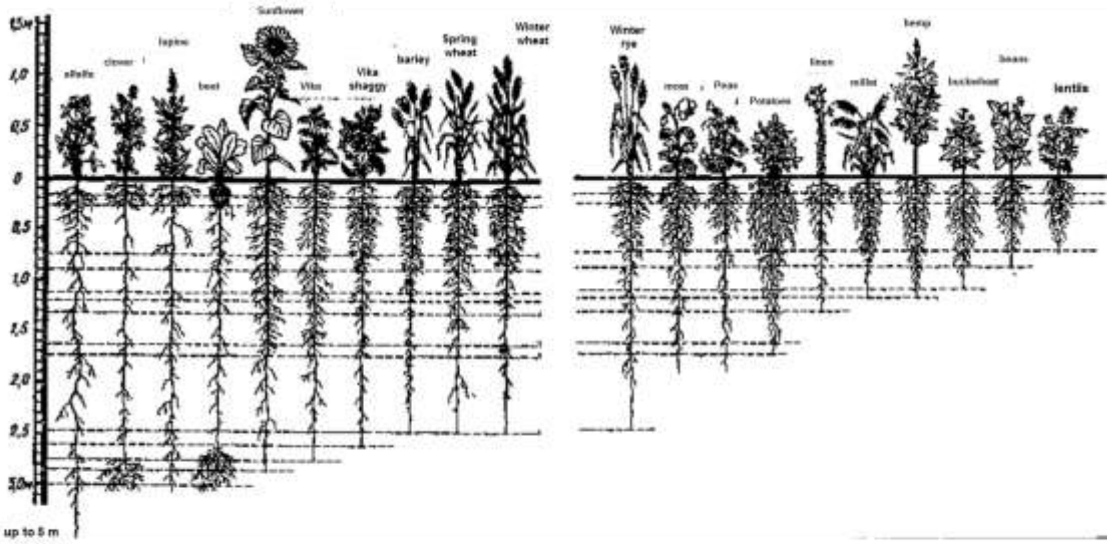


Figure 3 **The depth of penetration of the roots of different crops into the soil (Польский Б.Н., 1977)**

With the introduction of root and stubble residues into the soil, the biological activity of soils, the content and reserves of humus, the content of water-resistant aggregates, water permeability and the coefficient of soil filtration increase (Иванов В.Д. *et al*., 1990; Косцов Г.В., 1971; Мирцхулава Ц.Е., 1975).

Unlike cultivated plants, the ameliorative effect of forest vegetation on the soil, due to its distinctive biological features, increases substantially.

To successfully combat water erosion of soils, it is necessary to make more extensive use of soil protection and agro-ameliorative functions of vegetation. Consideration of the influence of vegetation on the sink of melt water and the washing away of soil from the slopes is of scientific and practical interest. In the most general form, the nature of this influence is well known. At the same time, the quantitative assessment of the drain-regulatory and soil-protective efficacy of herbal given schematically as separate scientific reports.

In them, the indicators of water flow and soil washout are most often of a private nature and reflect local (local) conditions for the formation of liquid and solid runoff in relation to a specific locality and the hydro-meteorological situation of this year or a short period of years. Therefore, in all cases when it becomes necessary to take into account the influence of vegetation on the runoff of water and the washing away of the soil, the researcher always experiences difficulties due to the lack of generalized and sufficiently substantiated average long-term indicators for a specific type of soil (Польский Б.Н., 1977).

On the basis of numerous experimental data, we sought to reveal the influence of vegetation on the surface slope drainage of melt water in relation to the prevailing types of soils of the Central Forest Steppe. For these purposes of numerous scientific information was used, in which the slope runoff of melt water from various agro-phones (plow land, winter crops, stubble, perennial grasses, fallow, pasture, and forest) was taken into account.

The materials of a number of researchers were used as the basis for determining the influence of vegetation on the surface runoff of thawed waters and washing away the soil from slopes.

Earlier, it was noted the expediency of placing perennial grasses in the lower part of the slope on the grounds of the petition and hydrographic funds. The inexpediency of locating perennial grasses in the upper section of the slope is indicated by the fact that in this case the mass of flowing melt water from the overlying sections of the slope to the lower ones increases. The latter enhances the erosion of soil from arable slopes not protected by vegetation, and leads to additional costs for protecting the soil from erosion in the lower part of the slope. This circumstance should be taken into account when selecting sites for permanent tilling and placement of special soil protection crop rotations.

Of particular interest is the establishment of soil protective effectiveness of vegetation. Without taking into account the soil protection effectiveness of vegetation, it is impossible to build an optimal anti-erosion complex, to determine the effectiveness of the adopted crop rotation and the rational structure of crop areas.

## CONCLUSIONS

Effective use of moisture in crop rotation is possible only when alternating crops that have a deep and shallow root system. The moisture cycle under annual crops is carried out in the soil layer 0-150 cm, and under perennial in the soil layer 0-300 cm.

Pure steam keeps moisture well in the sowing of winter crops. The addition of moisture reserves in the soil layer 0-100 cm (as a percentage of the lowest moisture capacity) per pair, as compared with the non-steam precursors, varies from 2-3 in the forest-steppe zone to 10-15% in the steppe zone. In areas of sufficient moisture, it is economically justified to introduce occupied fumes instead of clean ones.

On plowed fields, where the soil is washed away more than 12 tons per hectare, special soil protection crop rotations with perennial grasses and crops of continuous planting are organized. When developing the structure of crop rotations and their location, it is necessary to take into account the level of decline in yields of crops on soils of different degree of erosion.

The main role in the successful implementation of tasks to protect the soil from erosion belongs to land management, in the process of which an erosion organization of the territory is conducted and the necessary territorial conditions are created to implement measures to prevent erosion processes and restore the fertility of eroded lands.

It is important to determine the soil-protective effectiveness of forest streaks. Obviously, the areas occupied by forest belts will have such a coefficient of protection from spring flushing of soils from the slopes, as well as areas under the forest.

However, the soil-protective function of the stock-regulating forest belts extends to the area near the forest belts.

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