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BASIC PROCESSES AND FEATURES OF SOIL EVOLUTION IN CONDITIONS OF RE-CULTIVED LANDSCAPES IN THE PRUT-DNIESTER INTERSTREAM AREA

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Key words: re-cultivation, the processes of soil forming, evolution, eroded and replanted soils and their properties, crop capacity, economical efficient.

Abstract. In this work are presented materials of long-term research on re-cultivated soils, the processes of evolution of their properties are established, and also the structures of a soil cover of eroded territories in conditions of re-cultivation. The course, direction and interconnections of elementary processes of soil formation are considered in the replanted soils and peculiarities regulation of elements of their fertility and protection.

Introduction

In conditions when the areas of the fertile lands is accelerated are reduced more and more actual there is a problem of re-cultivation of eroded soils, restoration of their efficiency, economic, aesthetic and nature protection value.

The problem of the re-cultivation the degraded soil includes some components. In the soil-ecological plan it assumes maintenance of soil forming processes; in geobotanical - restoration biogeocenosis; in generally ecological - restoration the ecosystems soil functions and improvement of quality of environment. The marked components are interconnected and assume determined the approach.

Thus the tasks solved by the teaching about re-cultivation, are considerably more extensive is the problems of the constructive ecology, the industrial biocenology, the landscape construction, that is creation the high-grade new agricultural.

In this context, rather actual the researches about the study of soil forming in the conditions of re-cultivation landscapes. These researches bring in the essential contribution in development of theoretical rules of pedology about a role of the natural and anthropogenous factors of soil forming.

1. Materials and methods

The object of research – the replanted soil in Central Moldavian soil province. The methods of research - expedition, stationary, field, cartographical, analytical, mathematical-statistical.

2. Results and disscusions

According to set forth above principles the method of re-cultivation is intended for: the creation of nature-anthropogenous soil profiles, which basic parameters correspond to bioclimatic conditions of soil area; provide of formation of homogeneous soil profiles; provide of processes of circulation of substances in a soil profile.

Proceeding from these purposes (requirements), at realization of works of re-cultivation were used local replants, which properties were generated in the given concrete conditions of soil area, that has ensured compatibility of the eroded soil and the replants.

By earlier researches is established, that the restoration of a soil cover on the eroded grounds is accompanied by improvement of landscape conditions as a whole [5, 6, 7, 11], that creates conditions for: of homogenization of structure of a soil cover, and, accordingly, and basic functions of soil (hydrological, energetic, bioproductive etc.) in the structure of ecosystems; increases of permeability, stocks of a productive moisture in soil, decrease of a superficial drain; creations of favourable conditions for homogenization of the biological factor and development of the certain combinations of fitocenozes, than the increase to productive potentials of agroecosystems is provided; increases of productivity of agricultural cultures, that results in increase of capacity and complication of a biological revolution of substances, and also the quantity of organic substances involved in soil forming process; maintenance is artificial of the created soil profile with favourable, approached to natural ecological steady conditions for development and deep penetration of roots of plants; maintenance of favourable environment for accumulation, transformation and migration of substances.

The marked changes create favourable conditions for renewal of a number of elementary soil forming processes caused by bioclimatic conditions of region, for purposeful intesification of last and initiation of a number of new (nature-anthropogenous) processes ensuring evolution of the replanted soil [5, 6].

The basic components of soil forming process are:

- creation, accumulation, migration and transformation of humus substances;
- biological accumulation of chemical elements;
- migration of the carbonates and desalinization of structure of a soil solution;

- structuring and improvement of pore condition of soil;
- transformation of a mineral phase of soil with creation of active substances causing increase of capacity of absorption and of occlusion function of soil;
- homogenization of a soil profile and differentiation of genetic horizons.

The marked processes are characteristic for all kinds of replanted soils, at the same time their quantitative expression is determined by an initial condition and formation of denuded soil, the replant nature, capacity of drift layer and local bioclimatic conditions.

From generalization of the dates, received by us, follows, that under influence of replants all basic parameters are exposed practically to changes. Is established, that the period of 20-25 years of agricultural use of replants soil promotes for creation of the rather homogeneous soil profiles. The field researches have shown, that in most cases transitions between horizons of a soil profile are gradual, with some exceptions caused by a nature of the replant and technology of their drifting. At the same time, the morfometric research testify, that these profiles have passed a difficult way of formation. The first years after re-cultivation in a profile of soil were appreciable layers the replants and initial soil. Their characteristic attributes for this stage is the bulk shape often which is not contacting with initial severely denuded soil (by horizon BC). Especially it was well shown on replanted severely denuded calcic Chernozem, layer 45 sm. In due course, on a measure of become and the complications of an exchange of substances, between these layers in a soil profile were established processes of their homogenization. The paramount importance in realization of the named process had the phenomenon of movement of a soil moisture. A significant role the processes of development of root system of agricultural plants, and also soil fauna, first of all earthings have played.

Higher contents of organic substance in replant, including not completely spread out, has resulted in increase of number of the earthings in the top layer of a soil profile (replant), and in process of evolution of a profile the processes of moving of substances of earthings, and also mechanical processes of displacement of substances on courses of earthing and micropores have begun. The formation of last is caused by a contrast mode of humidifying.

The large role on compatibilities of drifing replants and the course of soil forming processes render grain size and microaggregatic composition, on which the water-physical properties depend: permeability, soil moisture tension, water capacity and others. Thus the grain size and the structural – aggregate composition in the wide sizes renders influence on character of a water mode, so and on conditions of grows the agricultural cultures, the speed of movement of mobile nutritious substances etc. From mineralogical and chemical structure, connected to it, depends the contents of nutritious substances (potassium, phosphorus, sulphur,

calcium). The processes, mainly of mechanical homogenization of a soil profile, have created favourable conditions for moving of fine flocculated particles and become of processes of homogenization of a profile to the grain size composition (Fig. 1).

The generalization of our experimental dates testifies to formation concerning homogeneous profiles on grain size composition. Use in these purposes of a parameter of uniformity of a profile offered N.A. Dimo (< 0,001 mm / < 0,01 mm), shows, that its homogenization is promoted by processes of moving the fine flocculated fractions on all profile of soil.

Alongside with it we designed also parameter (< 0,001 mm / > 0,01 mm), which, on our sight, can be used with the purposes of definition of a degree of moving the fine flocculated (< 0,001mm) and the large flocculated particles (< 0,001 mm). The dates, received by us, confirm a conclusion about uniform spatial migration of the fine flocculated particles. It testifies that the process of moving of the high flocculated particles does not carry simple mechanical character, and is closely interconnected to an initial condition of soil, on the one side, and the nature, structure and properties of replants with another.

On stationary experience, where was spent the re-cultivation by severely denuded grey soil on variant with drifting in quality of replant the deluvial molic soil higher degree of migration the fine flocculated particles on a soil profile with preservation of the eluvial-iluvial structure is established. Obviously, it is caused by the greater mobility organo-mineral of colloidal particles of grey soil. Formation of eluvial horizon puts on the brake desilting of the silt replant.

It is known, that with grain size composition is closely connected the soil humus condition [13]. The experimental dates, received by us, confirm this rule. On our sight, the homogenization of grain size composition of soil has created favourable conditions for intensive development of processes of formation and accumulation of humus with formation the rather deeply humus profiles. At the same time, the preservation of texture differentiation of a soil profile of the replanted grey soil interferes with above named processes.

The research of the soil humus condition has shown, that the quantity of the humus on variants of experiences is determined by a nature (kind, thickness) of drifting replants and initial eroded soil (Fig.2). Depending on thickness of drifting replants the stocks of humus in a root layer are increased in comparison with initial soil (control) on variants with the silt sediment in 1,8-3,3; with the deluvial molic soil 1,5-2,7; the deluvial ocrik soil 2,5-3,6; the typical low humic Chernozem in 3-5 times. The general stocks in a meter layer make 350-400 tons / ha. Under the contents of humus the variants with drifting replants 30 and 45 cm are close to replant (transplant), less of humus contains in soil with the put layer 15 cm, in arabil horizon - 1,2 -1,5%. The distribution of humus on the layers corresponds of

replant to a level of drifting of a layer of soil, and is farther to horizon of severely eroded soil. The appreciable transition it is traced on border between the replant and initial soil, it testifies that the process of soi forming yet has not reached a complete phase of balance. Its greatest quantity is marked on variants with replants of the Chernozems and the alluvial mean halomorfic soil - 4,31 %, and least on variant with the deluvial molic soil - 1,17 % and the silt sediments f ponds. If to look after dynamics (evolution) of humus of the replanted soils a beginning of a bookmark of stationary experiences, the following feature is found out. As a result of the long period of agricultural use of replanted soil and their annual fallowing there is a tendency of migration of penetration of humus from top arabial layers in down horizons (30-50 cm). It is precisely traced on variants with 15 cm by a layer on all stationary experiences and especially with the silt, deluvial molik replants. The results of the physico-chemical analyses show on some reduction of the humus contents in time. However, despite of these negative phenomena, the humus contents is rather stable, that specifies necessity of application of the systems of biological cultivation.

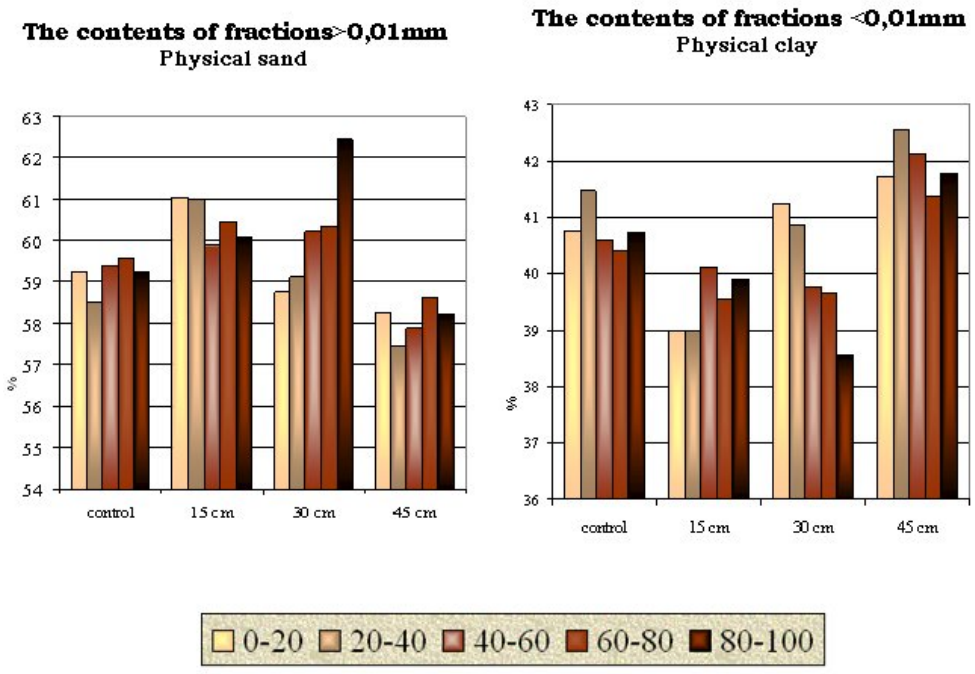

Fig. 1. The grain size composition of the replanted leached Chernozem «Lapushna-1», 2001-2002 years

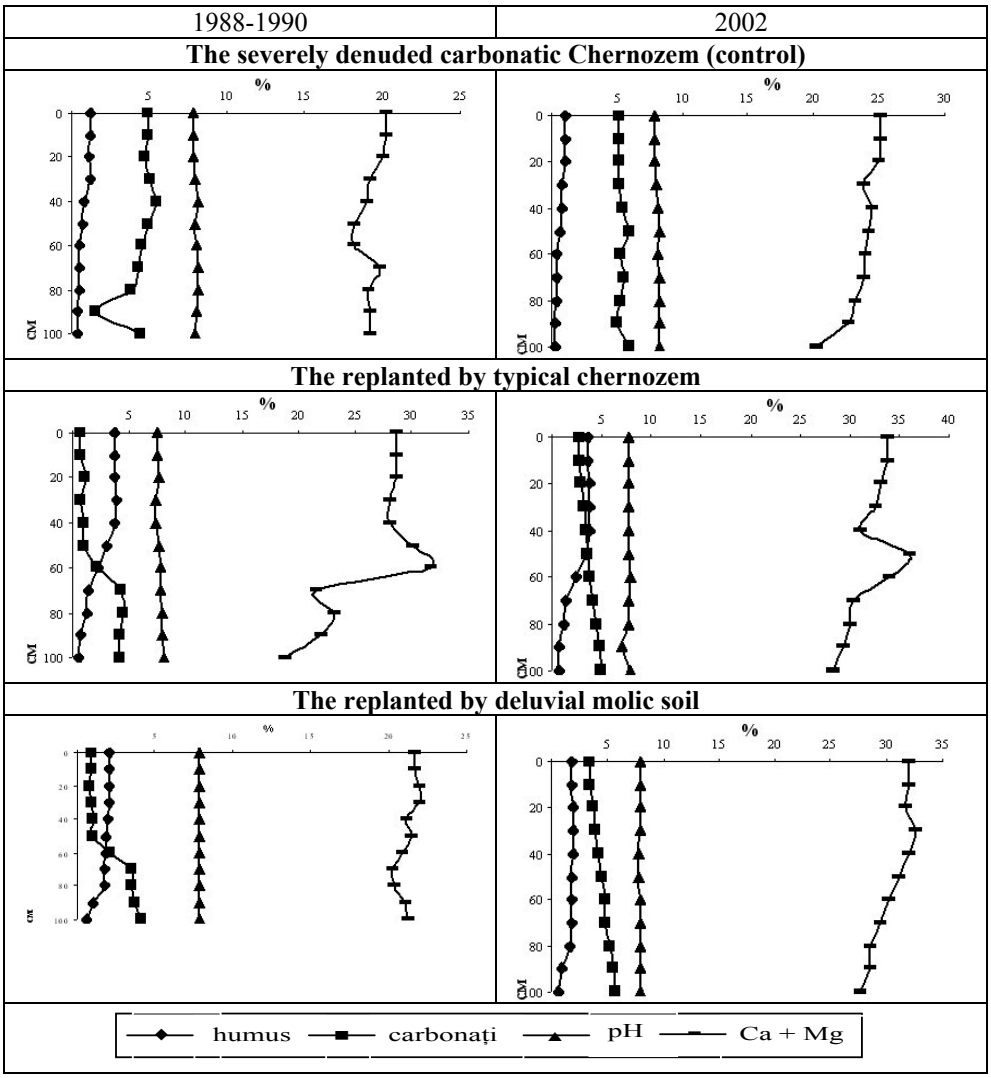

Fig. 2 (a) - The changes of physical- chemical parameters of replants severely denuded calcic Chernozem

On stationary experience in the replanted grey soils with silt sediments the contents of humus is 1,32 % (the layer 15 cm); 1,40 % (the layer 30 cm); 1,42 % (the layer 45 cm); the deluvial molic - 1,19 (the layer 15 cm); 1,18 % (the layer 30 cm) and 1,20 % (the layer 45 cm) and the deluvial okric soil is 1,32 % (the layer 15

cm); 1,40 % (the layer 30 cm); 1,42 % (the layer 45 cm), where on the control makes 0,53 %. Its greatest contents is observed on the replanted soil of the Chernozem layers and the silt sediment of a pond 30 and 45 cm and is equalled accordingly 1,40; and 1,42 %, and least on variant with the deluvial grey soil.

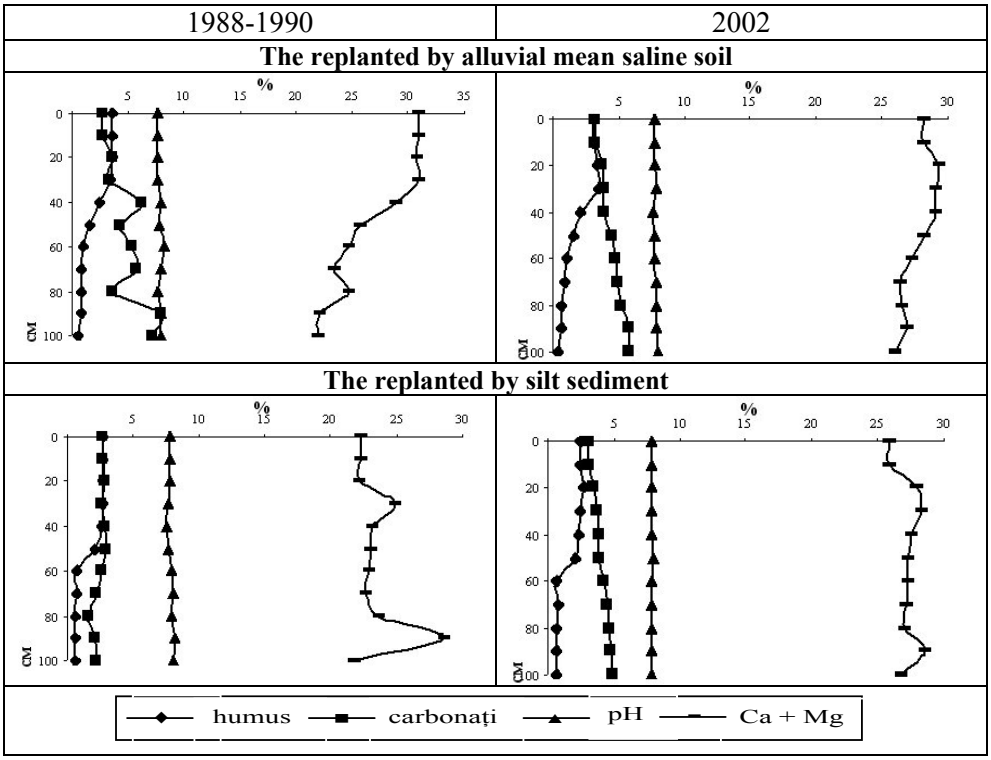

Fig. 2 (b) - The changes of physical- chemical parameters of replants severely denuded calcic Chernozem

On the replanted leached Chernozem the humus contents also is determined by a replant nature. On the severely calcic Chernozem which replanted by typical Chernozem, the contents of humus is 3,61 %; the deluvial okric soil is 1,73 %; the alluvial mean saline soil is 3,11 % and the silt sediment of a pond is 2,44 %, whereas on the control is 1,01 % (Fig.2) and on the severely leached Chernozem which replanted by the Chernozem-like soil is 1,39 % (layer 15 cm); 2,39 % (layer 30 cm); 2,19 % (layer 45 cm), and on the control is 1,24 %. The replanted soil with the Chernozem-like layers richest of humus, but its vertical recession sharpest.

The contents of humus in many replanted soils is in direct dependence from them claying. The horizon of the replant differs from its making horizons of initial soil of isotropic properties on a vertical increased of anisotropic on horizons (3).

Rather heavy grain size composition in a combination to the favourable contents of humus promotes increase of parameters of capacity of absorption. The data on dynamics of capacity of absorption specify on a gradual increase in time that, obviously, is connected to processes of evolution of components of a firm phase in the again created landscape conditions. We consider that the basic role in increase of capacity of absorption belongs to processes of formation and accumulation of humus. It, on our sight, explains processes of reduction of capacity of absorption on variant with grey soil. All variants of the replanted soils are characterized by high parameters of exchangeable cations. For the replanted severely calcic Chernozems the insignificant increase of the contents exchangeable cations is characteristic at the expense of increase of a share of magnesium. In the same time the contents of exchange calcium downwards on a profile is a little reduced.

In the replanted severely grey soil the contents of exchangeable cations considerably differs from the control (initial soil). The maximum them is marked on variants with the silt sediments, where the increase of the magnesium is precisely traced.

At the same time, certain importance has also the processes of transformation of a mineral complex of the soil in the again created conditions. In the replanted soil the active processes of decomposition primary were established, and can be and secondary minerals, in this connection the increase of quantity of the magnesium in a soil-absorbing complex is marked.

Designed on the basis of the dates of the grain size and microagregatic analyses the parameters of the structure testify to high potential of micro- and macro aggregation of the soil.

In this context Kachinski (9), Canarache (2), Jigau (5) show, that the special interest represents the contents of fine flocculated clay and mineralogical composition. In opinion of the above named authors (2, 5, 9) the minimal contents of the fine flocculated clay necessary for realization of structure processes, makes 15 %. The greatest effect of structure is reached at the contents in soil from 15 up to 40 % of fine flocculated clay. At presence less than 15 % in soil is formed fragile units, and at presence more than 40 % is created the preconditions for formation only the merged blocky, extremely poor-quality units.

At the contents from 15 up to 40% a fraction <0,001 mm are provided formation connection between by grain size particles >0,001 mm and formation of bean-shaped –granular structure or granular- bean shaped structure. In this

connection matters not only the contents of fine flocculated clay, but also than particles is larger 0,001 mm, first of all of particles of 0,05 -0,01 mm. In this plan our researches have shown, that the replanted soils correspond to the named requirements.

The combination of all sizes of the named conditions causes some mechanisms of formation of structural units. The greatest importances have the processes of pasting of elementary soil particles by means of the colloidal substances with the subsequent condensation again of formed units. By grain size composition, contents, character of humus distribution follows, that in the top horizon of the replanted soil the mineral and organic colloidal substance participate in structure of soil weight in identical quantities with formation of valuable structure. In transitive horizon the share of participation the organic colloidal substances a little decreases and the role of the mineral colloidal substances in structure of soil weight is essentially increased, owing to what the agronomical valuable structure is characterized by smaller mechanical durability and smaller water retaining capacity.

Alongside with processes of pasting in structure of the replanted soil the important meaning have also processes of fragmentation of soil weight owing to drying and compression by last. And in this case structural units of the cube-like form are formed. At the same time, they are characterized by a significant degree of mechanical durability, but at the same time, weak soil moisture tension. The disintegration of such units at humidifying is accompanied by formation of units by a diameter of 3-1 mm. The increase of quantity last in structure of structure of an arable layer promotes increase of a specific surface of soil weight. The subsequent drying of soil is accompanied by formation in the top part of an arable layer strong crust, which thickness makes from some millimetres up to some centimetres. Last interferes of gas change between the soil and atmosphere, and also occurrence the young growths on a surface.

Agrees Jigau [5] from the moment of an establishment of structure processes in soil the new stage of development of bioinert system begins. From the moment of formation of structure the exchange of substances between various pieces of the replanted soil begins.

In process of development of structure processes and evolution of quality of structure the depth washing of a soil structure is increased, that results in the beginning of processes of carbonate migration on a soil profile. On the dates of Afanasieva [1] last give again formed replanted soil stability in time and space.

The presence the carbonates in soil determines a type of humusoformation. Is established, that the quantity of carbonates, their distribution depends on a kind, capacity of replant and of initial severely eroded soil. For replanted average and severely Chernozems the presence of carbonates from a surface on all profile is

characteristic, which maximum is observed in the mother land breed. Per the first years after used the replanted grey soil the carbonates on a profile are absent or contain in insignificant quantity. For the period of used the general tendency on all variants of experiences of increase of the carbonates contents is observed, that is connected to migration, pulling up them to a surface. Is especially traced on variants 30, 45 cm in the replanted severely leached and calcic Chernozems.

The bulk density of replanted soil per the first years of their use is subject to the greatest changes in top layer. The highest sizes are in the initial severely solid and on variant 15 cm, downwards on a profile it sharply grows. For the period of use of replanted soil the size of bulk density in top of 0-50 cm a layer with drifting replant 30, 45 cm are close among themselves, the alignment of this parameter (the bulk density) is observed. It specifies improvement of a parameter of addition of soil that is connected to homogenization of a soil structure.

As have shown researches, at re-cultivation of eroded land large importance there is all drifting weight a layer of soil, it grain size composition, aggregation, contents of nutritious elements, nitrogen. As if to the contents of humus, the carried out analysis of materials has shown, that during development of humus layers, their transportation and lay-out on the eroded sites their structure changes, they get in completely other ecological conditions. After loss the replant on a day time surface they are exposed to intensive influence of solar radiation (energy) of oxygen, water. Therefore the soil forming processes in them proceeds in a direction of purchase of new attributes, structure and properties appropriate changed to ecological conditions.

The presence at silts, but also in the eroded soil the increased quantities of the fresh not spread out mineral substance causes high intensity the processes of weathering. Last are promoted also by processes of biochemical transformation of organic substances. Thereof the soil forming processes in the re-cultivation landscapes carry the accelerated character. This phenomenon is entered in the general tendency of the re-cultivation landscapes to achievement of power balance with an environment.

Conclusions

On the basis of the received dates it is possible to conclude, that that the method of re-cultivation is not by simple receptions the restoration of capacity of eroded soils, and powerful factor of reproduction of soil forming processes ensuring, in time, improvement of an ecological condition of eroded territories.

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