Issues of Soil and Ecological Efficiency of Land Reclamation and Justification of the Possibility of Restoration of the Properties of Chernozems

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Abstract. Currently, much attention is paid to scientific and reasonable development of ecologically favorable environment. In relation to soil cover is getting a good yield, the creation of a special parks, landscaping, design and creation of soil structures for lawns, sports fields. For science-based establishment of soil structures, it is necessary to know the water-physical properties of the material, the laws of movement of moisture, formation of soil layers. Methods for the study of soil is intimately associated with the doctrine of V. V. Dokuchaev on the soil. As a result of interaction of soil formation factors soil acquires certain properties, with the change of soil-forming factors, these properties will naturally vary. In parallel with the comprehensive study of the factors of soil formation in the study area are studied in detail the soil — their outward signs, and most importantly, the chemical and physical properties.

1. Introduction

The direction of the Russian economy in the field of nature management without observing the principles of rational use of natural resources has led to a considerable scale of the removal of disturbed lands from agriculture and forestry. These are sites on which the quality of the environment deteriorates, the ecological situation. To the violation of land, changing parameters and indicators of ecosystem elements, led large-scale volumes of development of deposits of useful resources, the organization of landfill waste storages, occupying large areas. The consequences of uncontrolled impacts and the thoughtless use of landscape areas have led to a decline in fertility efficiency. Soils become unsuitable for the growth and development of plants due to the lack of organic matter and nitrogen, depleted nutrients.

2. Objects and methods

Osnovopolozhnik geneticheskogo pochvovedeniya Vasiliy Vasil'yevich Dokuchaev otmechal, chto russkiy chernozem unikalен, prezhde vsego, svoim gumusovym profilem. Osobyе znacheniye dannomu tipu pridayet, dostigayushchaya dvukh metrov, moshchnost' gumusovogo gorizonta. Nesmotrya na to, chto chernozemy davno i tshchatel'no issleduyutsya pochvovedami, ostayetsya mnogo nereshennykh problem. Oni svyazany s genezisom, svoystvami i sostavom pochv. Chernozemy – luchshie zemli Zapadnoy Sibiri. Oni zanimayut boleye 13 mln ga. No bezdumnaya deyatel'nost' cheloveka, kotoraya svyazana s ikh nepravil'nym i postoyannym ispol'zovaniyem, a takzhe prirodnyye usloviya, sozdayut predposyliki dlya vozniknoveniya antropogennoy degradatsii etikh zemel' [4].
V rabote byla postavlena tsel' provesti issledovaniye vozmozhnosti biologicheskoy re-kul'tivatsii. Zadacha biologicheskoy rekul'tivatsii narushennykh zemel' i zaklyuchayetsya v tom, chtoby kompleksom agrotekhnikheskih i fitomeliorativnykh priyemov uluchshit' strukturnoye sostoyaniye, vodno-vozdushnyy i pishchevoy rezhim, a tak zhe biologicheskiye osobennosti narushennykh zemel' s tsel'yu dal'neishego ikh effektivnogo ispol'zovaniya v narodnom khozyaystve.

The founder of genetic pedology, Vasily Dokuchaev, noted that the Russian chernozem is unique, above all, its humus profile. Of particular importance to this type is the thickness of the humus horizon, reaching two meters. Despite the fact that chernozems have long been studied thoroughly by pedologists, many unresolved problems remain. They are related to genesis, properties and composition of soils. Chernozems are the best lands of Western Siberia. They occupy more than 13 million hectares. But the man's thoughtless activity, which is associated with their incorrect and constant use, as well as natural conditions, creates the prerequisites for anthropogenic degradation of these lands [1].

The goal was to conduct a study of the possibility of biological re-cultivation. The task of biological recultivation of disturbed lands is to improve the structural state, water and air and food regime, as well as the biological characteristics of disturbed lands, with the aim of further their effective use in the national economy by a complex of agrotechnical and phytomeliorative techniques.

Methods for studying the soil are closely related to the theory of VV Dokuchaev on soil. As a result of the interaction of soil formation factors, the soil acquires certain properties, with the change in the factors of soil formation these properties will naturally change. In parallel with the complex study of soil formation factors in the investigated territory, the soils themselves are studied in detail - their external features, and, most importantly, chemical and physical properties. At present, various types of chemical analyzes, analyzes of physical properties, mineralogical, thermochemical, X-ray structural, spectral, microbiological and many others are used in soil research. As a result, a definite relationship is established in the change of certain soil properties with a change in the soil-forming factors. Knowing the patterns of distribution of soil-forming factors, it is possible to create a soil map for a vast territory.

The second method of soil research is the method of stationary studies. It consists in the systematic observation of any soil process. Field methods are intended for studying soil regimes, water and heat balances, soil cover structure, soil monitoring, soil mapping, land cadastre. Include route and stationary methods, as well as methods of soil keys. To create an interactive information system, methods of system analysis, as well as modern methods for identifying requirements in software systems, are used. The process of work on the creation of an interactive information system is supported by modern application software, which functions as a version control system, and integrated development environments.

3. Results and discussion

Soil resources are one of the necessary prerequisites for life. If the territory was not used for agricultural or other purposes, then at the end of time, natural mechanisms of self-purification restore fertile qualities, natural processes return the former structure, humus is formed. This process is very slow. That is why the actual production of soils with optimal parameters, possessing high biological activity and preserving fertility for a long period of time became an important issue, which is important in innovative, scientific and economic plans.

When creating such soil, it is necessary to consider how safe the soil is and what qualities it should possess. In addition, it should not be expensive, so that it is possible to periodically replace the upper layers of the used areas. It should be possible to consider the depletion of soils under the influence of anthropogenic load. To do this, you need to understand - in what state is the soil, determine the particle size distribution, estimate the fertile layer, measure the pH, the content of some trace elements and heavy metals. It is not superfluous to measure the radiation background. It is necessary to consider the possibility of producing soil soils, taking into account the mineral resource base of the okrug with approved mineral reserves, eight of which include, in particular, peat and sapropel.
The land can be restored both for agricultural land, and for forest plantations or ornamental-planting complexes. Agricultural restoration of soil fertility can be conducted in various directions of crop production (field crop cultivation, meadow cultivation of vegetable growing, etc.). Irrespective of the specific purpose of the artificially created community (agricultural land, forest plantations or ornamental garden and park complexes), in all cases, stable soil and vegetation cover commensurate in terms of productivity with zonal communities and climatic features should be created on disturbed lands.

The climate of Western Siberia is characterized by different duration of the seasons of the year, uneven distribution of atmospheric precipitation. The coldest long period is November-March. During this period precipitation varies the height of the snow cover from 33 to 250 mm. In winter, there is almost no thaw, so the water reserves in the snow remain. Due to the significant negative temperatures and the fact that snow falls at the end of October and beginning of November mainly on frozen ground, an ice sheet forms in the upper layer, preventing the migration of melted waters deep into the water. Another specific feature of Western Siberia is the high intensity of spring processes: a sharp change in the nighttime negative air temperatures during snow melt (minus 10-15 °C) at relatively high daily temperatures (+ 10-16 °C). It is no accident that agriculture in these conditions is very risky. The erosion of chernozems is catastrophic. In recent decades, the anthropogenic load on the soil cover has increased many times. In areas of the Far North, producing oil and gas, inevitably there is anthropogenic degradation of soils, caused by a violation of natural vegetation, accumulation of slime deposits in the territory, oil spills. All this leads to environmental disasters of different scale. In the agricultural zone, soils are even more stressed, as the existing system of agriculture provides for the active use of agrochemicals and additional mechanical treatments. Taking into account the different conditions of soil formation, the nature of the man-made disturbance and the level of soil fertility, it is necessary to create various reclamation soils selected individually for each case. The traditional approach to recultivation of technogenically disturbed territories, caused by simple mechanical mixing of various components, leads to huge financial costs with minimal positive effect because soil physics is not taken into account. The traditional definition of physico-mechanical, water-physical and agrochemical properties of the source material is time-consuming and expensive, and the recultivation mix needs to be further investigated for compliance with each site to be reconstructed. To increase the efficiency of reclamation and restore the fertility of arable soils, it is necessary to develop rapid methods for determining the properties of the reclamation mix.

The choice of the method of preparing land for biological reclamation for agricultural purposes should be determined taking into account the agrochemical features of the rocks, their suitability for crops and on the basis of careful economic analysis. Restore the territory for agricultural purposes, and without applying the humus layer of soils, provided that the mineral fertilizers and crops of the perennial type will be applied.

The most common way to improve soils for agricultural development is "land". It consists in applying to the surface of the dumps a humus layer of soil or soils of different capacities suitable for growing plants. The thickness of the applied soil layer or potentially fertile soil will depend on the type of soil forming the surface layers of the dumps. It should be remembered that when applying to the surface of dumps of powerful soil layers or potentially fertile soil, an artificial, as a rule, fertile root layer is created for plants.

The thickness of the applied layer was calculated from the formula (1):

$$H = \frac{M}{\rho_b \cdot (W_{ppv} - W_{0,7ppv})}.$$  \hspace{1cm} (1)

where $H$ is the active soil layer, m; $M$ - irrigation norm, m$^3$/ha.; $\rho_b$ is the density of the active soil layer, t/m$^3$; $W_{ppv}$ is the optimum moisture content of the active soil layer, practically equal to or slightly less than the PPV; $W_{0,7ppv}$ - moisture of the active layer before watering [5]. The values of soil-hydrological constants were obtained and processed with the help of a developed software package.
designed for calculating the grain size distribution of the soil. The description of the program can be found in the article "Creation of a software complex for solving the problems of finding and calculating the values of the granulometric constituents of soil fractions according to specific humidity", which was published in the Eastern European Scientific Journal (Wschodnioeuropejskie Czasopismo naukowe) No. 6 (10). - Warsaw, Poland, 2016. - S. 100 - 105 [8].

For calculations, the mean value of the irrigation norm was equal to 1000 m$^3$/ha. The density of the active layer of the site was determined and amounted to 2.62 g/cm$^3$. Substituting all our data in the calculation formula, taking into account the reduction of units of measurement to one system, we obtain (2):

$$H = \frac{0.1}{2.62 \cdot 0.1} = 0.32 \text{ m.}$$

Thus, the thickness of the active layer of the investigated area is 0.32 m, which corresponds to the data of the research object.

The underlying rock is isolated from participation in the processes of initial soil formation, providing plants with mineral nutrition and moisture. The function of plants as a biological factor, which determines the soil-forming process, is reduced to the improvement of the applied layer. It is also proved that, when sowing the appropriate assortment of plants, highly productive plant communities are formed, in terms of phytomass stocks equal, and in some cases superior to natural zonal plant communities. The root systems of plants penetrate much deeper than the thickness of the applied layer, securing and enriching the soil particles with organic matter.

4. Conclusions
The formation of soils and the creation of their fertility occurs in the process of reclamation. The most effective method of recovery is applying to the surface of the humus layer of soils. Measures for soil restoration require a certain amount of time. During this period, the bulk soil should be enriched with nutrients, improve their structural state, activate biological processes by sowing meliorant crops, applying recommended fertilizer doses in combination with appropriate processing for the purpose of their further use in agriculture.

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