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PEDOGENIC INDICATORS OF THE LOWER VOLGA REGION

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ABSTRACT
The worldview of modern society is subject to transformational aspects, in which safe coexistence comes first. Global changes in the geographical envelope of the Earth reveal a number of problematic areas in the civilization of society, the solution of which can be the designated concepts. One of these areas will be considered in this article, namely, the development of methodological aspects for improving the soil with sapropel deposits in the Lower Volga region.

KEY WORDS
Geostructure, natural-territorial complex, soil fertility.

The development of the environment of modern society is a process of continuous activity of endogenous and exogenous forces of the Earth. Two powerful energy potentials involved in the formation of the planet's climate, geostructure, and landscape-geographical zones. The geographical envelope is formed and constantly updated only when three main combination components are combined, such as water, rocks, and incoming solar radiation. A continuous process in which a large geological cycle (the exchange of substances and chemical elements on a regular basis) and multiple loops of small biological cycle (the biocenosis). V.I. Vernadsky has identified three components of the functioning of biogeochemical systems:

- global level at which there is a formation of landscape-geographical zones with a combination of ecological communities, and surface and underground movement of substances and chemical elements;
- regional level - river basin systems;
- local level is represented by the landscape, where it is possible to regulate the processes of biogeochemization (the exchange of substances and chemical elements between animal bone matter, soils and ground water).

Over the entire geological period of our planet's development, endogenous and exogenous processes have done a tremendous job of structuring the modern relief and climatic components of the geographical envelope. Complex in structure, it forms natural complexes of different sizes, which are divided by the number of components and territorial size. In the course of such productive work, natural and territorial complexes are revealed, which differ from the surrounding territory in their main characteristics. Natural and territorial complexes are classified into two main groups, namely: zonal and azonal. Let's consider a unique formation on the example of the Lower Volga region as a zonal natural-territorial complex.

The zonal natural-territorial complex of the Lower Volga region forms the Northern part of the southern Federal district and covers the territory of the Republic of Kalmykia, Astrakhan and Volgograd regions and has access to the Caspian sea. The natural resource potential is diverse: thus, a significant territory is occupied by the Volga river valley, which in the South passes into the Caspian lowland

Consider one of the most important components that has a great impact on the highly efficient production of agricultural crop production - soil fertility.

Soil is the most important binding component in the system: the lithosphere, atmosphere, and biosphere, where soil properties are reflected only within this system.

For the fruitful use of the soil, first of all, it is necessary to consider the conditions and components of the formation of this resource.

The processes of formation of soil substances are ambiguous and they should be considered only if there are multiple indicators such as the destroyed parent rock as the basis for the formation of future soil, the changed chemical composition, the vital activity of organic compounds, climate indicators and speed indicators of the formation processes.

Scientists of the Russian scientific school V. V. Dokuchaev in the XIX century formed the concept of soil formation in the form of a quasi mathematical formula:

$$S = f(cl, p, r, v, o)t, \qquad (1)$$

Where: S is the soil or some soil property; cl is the climate; p is the parent rock; r is the terrain; v is vegetation; o is soil organisms – soil – forming factors; t is the time during which this soil was formed.

In His works, V. V. Dokuchaev gives priority to the fact that climate is the primary factor of soil diversity in Russia. But within the same zone, there are differences between the parent rock and the underlying surface of the soil.

Considering the development of soils using an equation does not directly account for changes in soil properties that occur as a result of their use for food production, plant fibers, and wood. Human economic activity is the main factor affecting the properties of soils in the inhabited areas of the Earth. This influence began in the Neolithic period, with the transition from an appropriating economy (hunting and gathering) to a more developed one – producing (agriculture, cattle breeding). Thus, in equation 1, it is necessary to enter additional parameters that characterize the use of land for agricultural purposes. The tangible impact of this factor began to appear only recently, often in spite of the natural development of soils. Even later, the use of chemicals for agricultural purposes, as well as the disposal of household and industrial waste, began. Therefore, it is necessary to extend equation 1 by adding land use as a soil-forming factor, i.e.:

$$S = f(cl, p, r, v, o)\, t_1 = (m)\, t_2 \qquad (2),$$

Where: S-soil or some soil property; cl-climate; p-parent rock; r-terrain; v-vegetation; o-soil organisms-soil-forming factors; t – time during which this soil was formed, m-factor of land use; t1 - the full period of time of soil formation; t2 – the time when land use began. [15]

On the territory of the Lower Volga region, there are several types of soils, namely: ordinary Chernozem, southern Chernozem, dark chestnut, chestnut, light chestnut and alluvial.

Consider the soil-forming factors in the Lower Volga region:

- The geological structure is represented by deposits of the Cenozoic, Mesozoic and Paleozoic groups overlain by Quaternary deposits. The parent rocks are quite diverse and heterogeneous, namely, from cover loams to outcrops of sea Sands, flakes, and limestones.

-Macro-relief of the studied territory: Volga upland-the watershed between the Volga and don valleys; a small section of the South – Eastern part of the Middle Russian upland is represented by the Pridon steppe and Kalachevskaya upland; Syrtovo Zavolzhye – large river valleys with wide watershed massifs (Uvaly and syrty); Volga river valley and Volga Delta – the valley has an asymmetric structure and reaches a width of 30 to 50 km, the Volga Delta forms a territorial triangle with an area of 12,000 km2; the Caspian lowland is a semi – desert plain with absolute elevations from +40 to-25 m; Yergeninskaya upland-bounded in the North-West and South by the valleys of the don, Western and Eastern Manychey rivers. In the East, a steep ledge breaks off to the Caspian lowland and only in the North it joins the Volga upland with a smooth transition; the Valley of the Western and Eastern Manych rivers is limited by the Ergeninsky upland in the North and the Stavropol uplift in the South [4,5,17,19].

- Climate indicators that affect the formation of soil resources in the Lower Volga region are characterized by a sharply continental type of climate.

The annual balance is: E concentrating – e reflected = 49.8 kcal / cm2. The total amount of solar radiation is more than 113 kcal / cm2.

The duration of sunshine is more than 2265 hours per year.

The duration of the period with temperatures above 0° C is 235-260 days (in the South up to 300 days). Sum of average daily air temperatures above 10° C for the Lower Volga region is 3400 ° - 3600 ° C.

The radiation characteristics of the climate zone are shown in Table 1.

Table 1 – Radiation characteristics of the Lower Volga region climate

Month-year	Number of days without sunshine	Total radiation, kcal / cm2	Radiation balance, kcal / cm2	The duration of sunshine, hours
January	18	2,6	- 0,2	70
February	10	4,3	0,6	101
March	6	8,7	2,8	132
April	2	11,8	6,2	212
May	1	16,3	8,8	296
June	0	16,9	9,0	312
July	0	16,9	8,9	331
August	0	14,7	7,7	299
September	1	10,3	4,2	245
October	6	6,1	1,7	159
November	11	3,2	0,2	65
December	19	1,7	- 0,1	43
Year	74	113,4	49,8	2265

The radiation balance is: solar energy (kcal/cm2 per hour) concentrated on the surface and energy reflected (not used (kcal/cm2 per hour).

The minimum amount of precipitation, decreasing from S-W to s-W from 500 mm to 170 mm, with evaporation exceeding 800 mm. The territory of the Lower Volga region is located in the zone of atmospheric fronts, with prevailing anticyclones that cause frequent droughts that negatively affect agriculture.

- The average relative humidity varies from 20 to 87 %. The maximum relative humidity is observed in winter. This is due to the fact that at low temperatures, even with a small absolute amount of moisture, the air is quickly saturated with water vapor. The minimum relative humidity is observed in summer. So, in July and August, it is 50%. The average minimum relative humidity reaches 20-30% in dry years. It should be taken into account that the amount of air humidity deficit is directly related to relative humidity [5].

- Temperature indicators reveal significant fluctuations in winter and summer temperatures. The annual amplitude of the air temperature reaches 33 ... 35°C.

- A separate criterion is to consider the temperature of the soil, because with such intense solar insolation, the soil horizon is intensively heated, which significantly affects the biological component. The minimum average soil temperature occurs in January at a depth of 0.2 m and reaches -9.4°C. The maximum average soil temperature is observed in July and August also at a depth of 0.2 m and reaches 29°C [5].

- Vegetation is represented by subzones, namely: forb-fescue-feather grass in the subzone of Chernozem and dark chestnut soils, belopolye-grass, with patches (halogenating) the type of vegetation in the area of chestnut soils, belopolye-romankova in the zone of light-chestnut soils, wormwood-grass in the zone of brown semi-desert soil, forb-fescue-feather grass in the floodplain Volgoakhtubinskaya [5].

- Hydrographic indicators of the Lower Volga region are not uniform, since the main river network is located in the Western part. The rest of the region, excluding the far North of the Volga region, is located within the semi-desert region of the Caspian lowland and does not have a river network. Surface runoff here is partly evaporated, partly filtered into the ground and only a small amount is collected in isolated depressions and highly saline lakes: Elton, Baskunchak, Sarpa, etc. This semi-desert region is crossed by the only river Volga. From artificial water sources, as noted on the Volga river, there is the Volgograd reservoir, on the Volga-don shipping channel named after V. I. Lenin there are three small reservoirs that

regulate the channel's supply-Karpov, Bereslav, Varvarovskoe, on the don river, on the South-Western border of the Volgograd region - Tsimlyansk reservoir, on the southern border of Kalmykia - with the Stavropol territory-Chograiskoe reservoir. Small reservoirs are available on the beams Yergeni, arsani - Seliminski etc. All reservoirs are used for irrigation, irrigation of pastures and other economic needs [5,14,18].

- Forest reclamation measures, namely man-made forest strips created at the end of the XX century, play a huge role in improving climate factors. And at the present time, these forest stands determine the potential for self-purification of agricultural landscapes, as well as contribute to the conservation and restoration of the gene pool and biological diversity of the ecosystem.

Table 2 – Comprehensive assessment of agroforestry potential of the Lower Volga region

Evaluation criterion	Number of points		Percentage of non-compliance,%
	assessed	the maximum according to the criterion	
Air temperature regime of the growing season	4	9	55,6
Sum of effective temperatures	6	9	33,3
Duration of the daylight length of the growing season	5	9	44,4
Length of the growing season	7	9	22,2
Soil fertility	5	9	44,4
Sum of points	27	45	40,0

Scale of assessment of agroforestry potential of the region:

- Less than 9 points – climate and soil are not suitable for growing protective forest stands;
- 10-19 points – the climate is conditionally suitable for growing woody plants, the share of influence of limiting factors is high and there is a risk of damage by adverse natural phenomena;
- 20-29 points – in General, the soil and climate conditions are favorable for protective afforestation;
- More than 30 points – the soil and climate conditions are optimal for protective afforestation.

The considered factors can be accepted with conditionality, since any soil formation passes a certain time period with accompanying conditions.

One such example is the analysis of light chestnut soils at the 0-20 horizon under consideration (Table 3).

Table 3 - indicators of integrated monitoring of soil fertility in agricultural lands of the Svetloyarsky district of the Volgograd region, 0-20

Controlled indicators	Ed. ed.	The actual value of the options			ND for testing
		I	II	III	
Alkaline hydrolyzable nitrogen	mg / kg	28,0	35,0	5,6	MUM 85
Mass fraction of mobile phosphorus compounds	mg / kg	34,6	8,5	7,7	GOST 26205-91
Mass fraction of mobile potassium compounds	mg / kg	233,0	376,0	96,0	GOST 26205-91
Aqueous extract					
Dense remainder	%	0,026	0,021	0,047	GOST 26423-85
Carbonate ion (the aqueous extract) Bicarbonate ion	mmol/kg	0,34	0,27	0,82	GOST 26424-85
Calcium	mmol/eq	0,12	0,10	0,49	GOST 26428-85
Magnesium	mmol/eq	0,15	0,14	0,28	GOST 26428-85
Sodium	mmol/eq	0,10	0,10	0,10	GOST 26427-85
The chloride ion	mmol/eq	0,12	0,09	0,12	GOST 26425-85
Sulfate ion	mmol/eq	0,12	0,10	0,06	GOST 26426-85

The Table shows that there are significant differences in indicators in the upper soil horizon for the variants, so:

- alkaline hydrolyzable nitrogen indicators range from 5.6 to 35.0;
- mass fraction of mobile phosphorus compounds from 7.7 to 34.6;
- mass fraction of mobile potassium compounds from 96.0 to 233.0.

As a result of the above, we can make an ambiguous conclusion that the soils of the Lower Volga region were formed under conditions of complex natural and climatic potential and at the present stage of geological development are represented by types and subtypes, as well as types and varieties of soils that have different genetic components in properties and have different levels of fertility.

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