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PRINCIPLES FOR ASSESSING THE ASSIMILATION POTENTIAL OF SOILS IN AZERBAIJAN'S BIOCLIMATIC SOILSCAPE ZONES IN RELATION TO ORGANIC POLLUTION

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Abstract. Considering that a significant part of the territory of Azerbaijan is polluted with organic and inorganic substances, a four-stage system of taxonomic units of zoning of the territory has been developed in order to assess the assimilation potential of soils of various bioclimatic landscape zones through a systematic analysis of abiotic and biotic factors that form the assimilation capacity and collectively determine the potential for self-purification. The proposed scheme will allow us to assess the assimilation potential of soils in bioclimatic landscape zones in a comparative aspect, the results obtained will make it possible to rank the soil cover of the country according to their self-cleaning ability in case of contamination with organic substances of different chemical nature.

Keywords: *soils, pollution, self-purification, assimilation potential, assessment system, zoning.*

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1. Introduction

There is no one polllution is so dangerous as damage of pipeline and oil drilling resulted with spillage of oil to enveronment. Widespread oil pollution, the number of pollution sources and influence of different compounds to nature are variable. Despite the constant improvement of oil transportation and extraction technology related to environmental protection, the urgency of this problem does not decrease both in the territory of Azerbaijan and throughout the world. In the 80s of the last century, the Absheron industrial region took the third place in the former Soviet Union due to the man-made impact of oil (100 t/km^2 per year) (Glazovsky, 1982). It is determined, that the area of the soil contaminated by oil and oil products is 12 thousand hectares, and the area of the waste of the chemical industry is 100 hectares (Ismailov *et al*., 2015).

In addition to oil and oil solutions, the ecosystems of our country are polluted with other organic substances named xenobiotics. For instance, pesticides, DDT (1,1,1-trichloro-2,2-bis(4-chlorophenylethane)), phenols, chlorinated benzfurans, polycyclic carbohydrates, herbicides, detergents and other substances also occupy an important place in the black list of xenobiotics. Most xenobiotics are difficult decomposes in the nature and accumulates in the soil, surface and underground water sources as well. Ultimately, pollution disrupts the natural balance, reduces soil fertility, and increases

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the mutagenic activity of the soil itself, which is a natural substrate (Baruah *et al*., 2014, Grachev *et al*., 2019).

Warm climate and soil irrigation management supports evaporation most of the organic matters that pollutes the soils cover into the air. For example, petroleum carbohydrats and pesticides spread to other areas, where they impact their negative effects. Even a significant amount of low-volatility pesticide such as DDT (commonly known as "dust"), approximately 60 percent of the used mass, is released into the air (Volgina *et al*., 2010). This leads to long-distance spreading of DDT and secondary contamination of the environment subjects such as rivers, soil and plants.

The weakeness of self-cleaning of the environment is related to such factors as the aridity of the climate, the insufficient weight of the ecosystem, and the low natural biodiversity. As a result, all these components create a high sensitivity to pollution, reduce the reproductive release of oxygen to 0.8 tons per year, weaken vegetation (the soil is relatively covered with plants only in spring and autumn), raise the level of groundwater (the water level has risen by 5-15 meters in the last 20 years), it lowers the bioclimatic potential and water-thermal regime. The relationships between different components of the landscape and the processes of supporting and replacing each other are disturbed accordinaly (Ismailov, 2006).

Years of experience show that the assimilation potential of Azerbaijan's natural landscapes is the economic problem of benefiting from natural resources. It is quite clear that soil wealth is complex of socio-economic features evaluation and that it is very difficult to measure it by quantitative methods. In this regard, studying the assimilation potential of our country's soil cover is extremely important for the development of promising directions of efficient use of natural soil resources and organic agriculture.

In order to perform these tasks, multilateral studies should be conducted to determine the actual assimilation potential of the soil cover and the factors affecting the assimilation potential of different bioclimatic landscapes, which are the components of the main ecosystem of the country.

The planning of effective economic measures for the protection of natural habitats, including soil cover from the harmful effects of pollution, should be based on the scientific basis of forecasting the changes in their condition in different natural and economic regions of the country.

The goal of such a forecast is conducted to complex differentiation of the territory of Azerbaijan according to the types of soil changes under the influence of pollution.

2. Outcomes and discussion

The four-stage system of the taxonomic units was developed for the zoning of the territory of Azerbaijan in order to assess the assimilation potential of soils in different bioclimatic landscape zones and to determine their overall potential through a systematic analysis of abiotic and biotic factors that form assimilation capacity.

The tasks of zoning include the assessment of natural-economic areas that differ in natural level of resistance to man-made loading, the ability to decompose organic pollutants, the degree of reversal of changes, and the determination of the level and character of these changes for each region based on the principle of landscape-territorial differentiation.

Because the landscapes of Azerbaijan are characterized by a wide range of natural conditions and factors, their potential resistance to organic pollution differs. Taking this into account, one of the conditions of regionalization is the comparative study of territorial characteristics according to their assimilation capacity.

Related to assimilation potential of landscapes, the most effective for zoning the territory of Azerbaijan is the system of four-stage taxonomic units with the following structure (Fig. 1):

a) assimilation potential of the country's soil cover;
b) assimilation potential of the zone;
c) assimilation region;
d) assimilation microregion.

The assimilation potential of the country's soil is important unit covering the territory of the country in the zoning scheme. This potential includes the complex of landscapes of the country, where the natural complexes are combined, mutually effective and their interaction is clearly expressed.

Assimilation zone – is an area characterized by a complex of natural conditions inherent to the assimilation potential of landscapes. On the territory of Azerbaijan landscape complexes can be distinguished, they are areas of assimilation characterized by different, dissimilar natural and climatic conditions. There are six bioclimatic landscape assimilation zones in Azerbaijan (Babaev *et al*., 2019):

1. Soils of alpine and subalpine meadows and meadow steppes;
2. Soils of mesophilic forests;
3. Soils of humid and semi-humid subtropics;
4. Soils of xerophilic forests and bushes;
5. Soils of river plains and lowsoil forests;
6. Soils of subtropical dry deserts and semi-deserts.

The pollution *assimilation distinct* is the next taxonomic unit characterized by the uniqueness of the area. The assimilation region is provided with the complex of soil and climate characteristics of the area, assimilation of pollution and natural factors of self-cleaning. The boundaries of pollution assimilation distincts may be connected to of the main soil types.

Assimilation microdistrict is the smallest taxonomic unit. This unit is characterized by a relatively homogeneous natural complex with relatively narrow indicators of self-cleaning factors and assimilation potential. The boundaries of the assimilation microdistrict may coincide with the distribution boundaries of the main soil subtypes.

The purpose of the evaluation process is to determine the degree of compatibility of the actual resource indicators of specific landscape elements, for example, soil cover. The actual self-cleaning ability value of a given area is determined by various assimilation factors.

As with soil fertility management capabilities (Mirkin, 2002), the pollution resistance of different soil types and their potential to manage their assimilation potential can be modified by a number of key constraints. These limiting factors include resources and economic factors that reflect the natural factors of the soil formation process. In a market economy, soil cover restoration after pollution and appropriate cleanup technology may be rejected if the most environmentally friendly management system and appropriate treatment technology do not match the financial and production capabilities of the region.

Resource limitations- these include "primary" constraints, soil formation factors that reflect the natural properties of soil in relation to climate, its relationship to topography and parent soil type. It is pretty clear that in an assimilation area where gray-brown soils are widespread, the constraints in controlling the assimilation capacity of soils will be different from an assimilation area dominated by chestnut-type soils. In the presence of gray-brown or gray soils, the limiting factors will be the amount of precipitation, soil salinity, the high risk of salts distribution to the surface during irrigation, and the lack of humus. Soil-climate conditions are more favorable to regulate their assimilation potential in the case of soil contamination with organic pollutants in chestnut soil types.

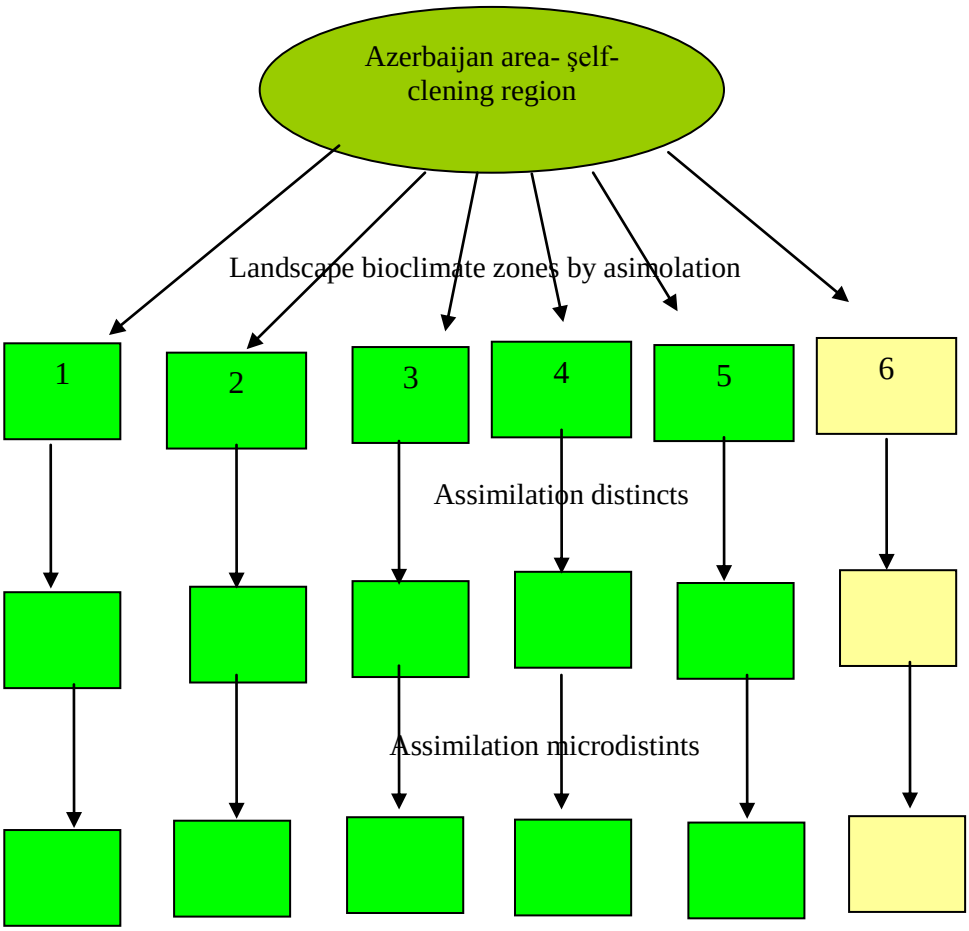

Fig.1. Scheme of a four-stage system of taxonomic units of zoning of the territory of Azerbaijan for assessment of the assimilation potential of soils of bioclimatic landscape zones.
Note: № 1-6 correspond to the bioclimatic landscape zones of the country's territory

In this regard, natural resource limitations should be taken into account when developing zonal systems for managing assimilation processes. Zonal management according to the types of soils will also apply to the selection of a number of necessary technologies and measures.

Biological limitations. With ecologically oriented management of assimilation potential, biological processes in the soil (the ratio of humus intensity and mineralization, total biological activity of the soil, the presence and activity of

microorganisms that decompose organic pollutants, etc.) are the main influence tools for managing the assimilation potential of the soil. However, any biological process occurring in the soil has its own upper intensity limits. Each soil type is characterized by its own microbial composition (Mishustin, 1975, Kruglov, 2016), its own zoocenoses (Gilyarov, 1965), the maximum possible level of enzymatic activity (Khaziyev, 2000), which ultimately determines the potential and actual assimilation of the soil cover, which determines the level of ability. Biological limits are manifested by the minimum time required for the decomposition of some organic pollution.

Economic limitations. Any system for managing soil restoration processes in a market economy is useful if it helps to obtain the maximum possible ecological impact with minimum production and financial costs. When developing technologies for the management of soil organic pollution, it is necessary to consider the risk of loss of soil resources and deterioration of their properties. So, if the developed technology is effective for cleaning the soil from organic pollution, but the remediation process causes erosion, secondary pollution, salinization or pollution of groundwater, reduction of the thickness of the humus horizon, if it poses a threat, then the negative impact of positive development on the environment is considered more important. On the other hand, if the source of pollution is removed in time when polluting the soil, then the concentration of the pollutant in the soil, such as petroleum products or pesticides, will gradually decrease and eventually reach a safe level. In such cases, from an ecological point of view, it is not correct to carry out special works on soil reclamation, because in this case there is a danger of causing even greater damage to the soil ecosystem.

If the concentration of the pollutant in the soil reaches the amount that will cause such negative ecological changes in the environment as disruption of the ecological balance in the soil ecosystem, soil animals losses, productivity decreases or plants losses, the risk of pollutant accumulation in plant products increases, there are changes in the morphology and water-physical properties of soils, their fertility decreases, if there is a danger of soil and surface water pollution as a result of pollutants entering the aquifers from the soil, the soil can be considered polluted.

When soils are contaminated with organic matter, three groups of environmental factors interact that must be considered when evaluating the consequences of contamination and the capacity to absorb contamination:

1) The complexity, multi-component composition of organic pollutants in the process of constant change, additional toxic substances in their composition;

2) The complexity, heterogeneity of the specific composition and structure of the soil ecosystem in the process of evolutionary development;

3) Diversity and variability of external factors (temperature, humidity, atmospheric conditions, precipitation, etc.) determine the biological activity and assimilation potential of soils.

When zoning soils are polluted with organic substances, such as petroleum carbohydrates, pesticides, phenols for comparative measurement of pollution resistance, a four-aspect system analysis of abiotic and biotic factors is proposed as an evaluation criterion, which forms the assimilation capacity and determines the self-cleaning potential in general (Ismailov & Najafova, 2021). These four aspects are described below:

- factors that determine the intensity of removal, migration and dispersion of organic pollutants: precipitation, average annual flow, denudation processes, number of days with a wind speed of 15 m/s per year, depth of groundwater,

hydraulic conductivity (ml/h), hydro relief, total evaporation (mm/day.km^2), evaporation rate (mm/day.km^2), soil water regime, etc.

- factors determining the possibility and intensity of fixation of organic pollutants: amount of humus (%), absorption capacity (mg.equiv./100g), mineral content of soils (physical clay %), alkaline-acidic conditions (pH), oxidation-reduction conditions and so on.
- factors affecting the rate of decomposition of organic pollutants: the amount of solar radiation (kcal/year), the sum of temperatures >15ºC per year, bioclimatic potential (BIP), productive moisture reserve (thousand mm), moisture coefficient, KU, number of microorganisms (thousand/g of soil), biomass of microorganisms, kg/ha, number and biomass of destructive microorganisms, kg/ha, mineralization coefficient (mg CO_2/kg soil/year), soil cover covered by plants and their productivity, annual absorption of organic pollutants by plant biomass, (g /day/ha), integral absorption of pollutants by plant biomass (g/day/ha per vegetation), etc.
- factors that determine the sensitivity of soil shafts to pollution: the structure of biocenoses (diversity of species).

3. Conclusion

The proposed system of four-stage taxonomic units developed for the zoning of the territory of Azerbaijan will allow to evaluate the assimilation potential of soils in the bioclimatic soil shaft in a comparative aspect using the methods of systematic analysis of the complex of biogenic and abiogenic factors. It will allow to divide the land cover of the country according to its self-cleaning capacity when polluted by various chemical organic substances.

The obtained results are scientific basis for assessing the assimilation capacity of Azerbaijan's ecosystems. Also, they are an indicator of the maximum dynamic capacity of the number of pollutants that can be collected, destroyed, transformed, and removed without disturbing the normal functioning of the country's ecosystems. It is a methodological basis for the development of programs and concepts for regulating and managing the use of nature on a scientific basis in different soil-climatic zones of Azerbaijan.

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