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DOI <https://doi.org/10.26661/2414-0287-2025-1-65-08>**ASSESSMENT OF SOIL QUALITY IN CONDITIONS OF SUSTAINABLE LAND USE****Selishcheva A.V., Hamova O.V., Zhuchkov R.F.***Zaporizhzhia National University**Ukraine, 69011, Zaporizhzhia, Universytetska str., 66**pereverzeva@ukr.net, gamova5oxana@gmail.com, Juchkovrem@ukr.net**ORCID: 0000-0001-8391-6636, 0000-0002-9752-6900***Key words:**

assessment, quality, soils, credit rating, sustainable development, resources.

The article is researched the assessment of soil quality under conditions of sustainable land use. It is substantiated that the soil is one of the main means for the production of products in agriculture and forestry, has multipurpose use and serves as a basis for the placement and development of productive forces, a place for people to settle. It is determined that 95% of the total amount of the food fund and two-thirds of the consumer goods fund is formed thanks to land resources. It has been proven that resource management in sustainable agriculture is important, because only with proper management, food security can be achieved due to the preservation and economical use of natural resources – soil, water, air. Note that at the current stage, soils around the world provide food for 7 billion people, but access is different and food is unevenly distributed, because 1 billion people suffer from hunger. In order to provide food for 9-10 billion people by 2050, it is necessary to significantly improve the biophysical, as well as socio-economic availability of food, as well as increase the production capacity. The quality of land is defined as its ability to perform certain functions, not to lose its properties over time. The functions that the land should perform are highlighted, namely: providing food, maintaining or improving water quality, and supporting human life. The main determinants of land quality are highlighted - soil productivity and stability, possible combinations form certain soil quality classes: the best agricultural soils (I, II, III classes) – temperate zone; classes IV, V and VI are found mainly in intertropical zones; classes VII, VIII and IX belong to fragile ecosystems and include tundra and desert areas. Bonification is considered as one of the methods of assessing the quality of soils, which involves determining the soil bonity index, which indicates its quality, natural properties and ability to produce the expected result. The need to develop policies and practices that promote sustainable land management, including the development of monitoring methods and warning indicators for land degradation, has been proven.

ОЦІНКА ЯКОСТІ ҐРУНТІВ В УМОВАХ СТАЛОГО ЗЕМЛЕКОРИСТУВАННЯ**Селіщева А.В., Гамова О.В., Жучков Р.Ф.***Запорізький національний університет**Україна, 69011, м. Запоріжжя, вул. Університетська, 66***Ключові слова:**

оцінка, якість, ґрунти, бонітетна оцінка, сталий розвиток, ресурси.

У статті досліджуються оцінка якості ґрунтів в умовах сталого землекористування. Обґрунтовано, що ґрунти є одним із головних засобів для виробництва продукції у сільському і лісовому господарстві, має багатоцільове використання та слугує базисом для розміщення і розвитку продуктивних сил, місцем розселення людей. Визначено, що 95 % від всього обсягу продовольчого фонду та дві третини фонду товарів споживання формується завдяки земельним ресурсам. Доведено, що управління ресурсами у сталому сільському господарстві має важливе значення, адже лише при правильному управлінні продовольча безпека може бути досягнута за рахунок збереження та ощадливого використання природних ресурсів – ґрунту, води, повітря. Зауважимо, що на сучасному етапі ґрунти в усьому світі забезпечують продовольством 7 млрд людей, проте доступ є різним і продовольство розподілено нерівномірно, адже 1 млрд людей страждають від голоду. Щоб забезпечити продовольством 9-10 млрд людей до 2050 року, необхідно суттєво покращити біофізичну, а також соціально-економічну доступність продовольства, а також підвищити потужність виробництва. Визначено якість землі як її здатність виконувати певні функції, не втрачати властивості з часом.

Виокремлено функції, які повинна виконувати земля, а саме: забезпечувати продовольством, підтримувати або покращувати якість води, підтримувати людське життя. Виділено основні детермінанти якості землі – продуктивність та стійкість ґрунту, можливі комбінації утворюють певні класи якості ґрунту: найкращі сільськогосподарські ґрунти (I, II, III класи) – помірний пояс; класи IV, V і VI зустрічаються переважно в міжтропічних зонах; класи VII, VIII та IX належать до крихких екосистем і включають тундрові та пустельні райони. Розглянуто бонітування як один із способів оцінки якості ґрунтів, який передбачає визначення показника- бонітету ґрунту, який вказує на його якість, природні властивості та здатність давати очікуваний результат. Доведено необхідність розробки політики та практики, яка сприяє сталому управлінню землею, що включає розвиток методів моніторингу та індикаторів попередження про деградацію землі.

Problem statement

Land is the main national wealth of our country, which is under special state protection. It is one of the main means for the production of products in agriculture and forestry, has multi-purpose use and serves as a basis for the placement and development of productive forces, a place for people to settle. Without such a resource as land, socio-economic, cultural and political development of the people is impossible.

Land can be considered one of the main foundations for the formation of a strong economy of the country, it is a reliable resource for the economic growth of the country. 95% of the total volume of the food fund and two-thirds of the consumer goods fund is formed thanks to land resources.

The development of land relations cannot be considered without interaction with ecology, because these two components are inextricably linked, their successful combination will ensure the preservation of nature as one of the important components of the biosphere.

In the economic and political sphere, soils act as bases and means of production. Their role of use in agriculture is very different compared to other branches of production. After all, soils in all other industries play a passive role, they are the foundation for production, while in agriculture, the soil is the object and tools of labor, thanks to which humanity grows the crops necessary to satisfy its needs.

Analysis of recent studies and publications

From the point of view of soil quality monitoring and assessment as one of the most important components of sustainable agriculture, the study was conducted by Ukrainian scientists, namely: Chorny S.H. [1], Radziy V.F. [2], Sokhnych A. [3], Panas R.M. [4], Pozniak S., Krasieha E., Kit M. [5] and others. Scientists outline issues related to quality monitoring and land use forecasting, land cover mapping, etc.

The mentioned works of scientists are a significant contribution to the development of the theory and practice of soil quality assessment in conditions of sustainable land use.

Highlighting previously unsolved parts of the overall problem

In the conditions of sustainable development, the assessment of soil quality requires a more in-depth study.

Objectives of the article

The purpose of the article is research and assessment of soil quality in conditions of sustainable land use.

Presentation of the main material

Resource management in sustainable agriculture is important, because only with proper management, food security can be achieved through the preservation and economical use of natural resources - soil, water, air, etc. Their availability and use in the future depends on rational and quality management today.

On the basis of the new concept of soil quality in the developed countries of the world (USA, EU countries), new soil monitoring systems were created already in the 21st century, which included not only monitoring of nutrient content, but also indicators of physical and physico-chemical properties, i.e. those indicators, which ensure the formation of a harvest of agricultural crops. In the new system of monitoring the condition of the soil, parameters were included that indicate the possibility of the soil realizing its social and ecosystem functions, in particular, indicators of the condition of the soil biota. And, therefore, such a monitoring system began to provide information about soils not only to producers of agricultural products, but also to managers who are concerned about the condition of soils on non-agricultural lands (industrial, under public development, 7 recreational, nature conservation lands, etc.). The quantitative and qualitative expansion of soil quality indicators in the USA and EU countries has led to the emergence of new problems related to the methods of determining these parameters, instrumentation for observations, personnel qualifications, etc. [1, c. 6].

Today, soils around the world provide food for 7 billion people. However, access varies and food is unevenly distributed, with 1 billion people suffering from hunger. In order to provide food for 9-10 billion people by 2050, it is necessary to significantly improve the biophysical, as well as socio-economic availability of food, as well as increase the production capacity. The ability of land users around the world to manage their soils rationally and productively in order to achieve high soil quality is of crucial importance [6].

The quality of land can be defined as its ability to perform certain functions, not to lose its properties over time. Among the many functions that land must perform is to

provide food, maintain or improve water quality, and support human life.

The main determinants of land quality are soil productivity and stability, possible combinations of which are presented in Table 1.

Table 1 – Matrix for determining land quality classes

Soil productivity	Soil stability		
	Low	Medium	High
low	IX	VIII	VI
average	VII	V	III
High	IV	II	I

Source: [6]

The best agricultural soils (I, II, III classes) are in the temperate zone. Classes IV, V and VI are found mainly in intertropical zones. Classes VII, VIII and IX belong to fragile ecosystems and include tundra and desert areas. Only a quarter of the world's population lives on land with high potential. About half of the world's population lives in lands with significant agricultural limitations, including long periods of soil moisture scarcity. And a quarter of the world's people have to survive on lands that are considered unsuitable [6].

The availability of food depends on the soil: nutritious and high-quality food and animal feed can only be produced if the soil is healthy. Over the past 50 years, advances in agricultural technology and increased demand from population growth have put soils under increasing pressure. In many countries, intensive crop production has depleted the soil, jeopardizing the soil's productive capacity and ability to meet the needs of future generations.

Soils are the basis of production and need care. But the exploitation of soils only intensified due to the increase in pressure. Arable land per person was 0.20 hectares in 2014, compared to about 0.37 hectares 50 years ago, according to the World Bank, with marked regional differences. This alarming trend calls for important investments needed to restore, maintain and gradually improve soil productivity.

Addressing soil security provides the means to improve food quality through enhanced soil care and the development of best land management practices. Soil is a fragile resource that is being degraded in many parts of the world. Rapid global population growth has put additional pressure on soil resources to meet the increased demand for soil-derived food. Such pressure accelerates degradation.

Soil security and food security are interrelated concepts that will help facilitate the implementation of the above solutions, so approaches that take this connection into account are needed.

Achieving and maintaining food security requires policy development and decision-making at the global and local levels, which require access to quality-assessed information at an appropriate scale.

Research shows that by 2050, global production of food and related ecosystem services is set to increase by 60%. However, one-third of global soils are now moderately to severely degraded through soil erosion, nutrient depletion, salinization, compaction and pollution. Evidence-based

decisions and soil information are critical to achieving sustainable soil management at all levels.

Smart soil management plays an important role in realizing the UN's Sustainable Development Goals (SDGs), which aim to end hunger, ensure food security and improve nutrition, and promote sustainable agriculture. This is particularly reflected in action point 2.4: "by 2030, ensure sustainable food production systems and implement sustainable agricultural practices that increase productivity and production and progressively improve land and soil quality." In other words, achieving food security is a challenge, maintaining it is another challenge, and soils are an important part of the solution [7].

One of the ways to assess the quality of soils is grading, which involves determining the soil grading index, which indicates its quality, natural properties, and ability to produce the expected result.

The task of credit rating is [8]:

- to determine and identify the most favorable soils for agricultural production, which are forbidden to be removed from agricultural use;
- compare and group the soils of the state, region, district, village council, individual land holdings according to their productivity (qualitative assessment);
- identify the most favorable soils for various agricultural crops;
- evaluate more objectively the territories with unproductive and degraded soils, where land conservation should be carried out;
- to help more correctly, taking into account the quality of soils, to implement modern rational farming systems, to carry out more productive specialization of farms;
- use the results of soil grading to develop measures to increase the yield of crops on different soils;
- carry out allotment of land in the process of land reform on the appropriate high organizational and legal basis;
- determine the amount of land tax and rent;
- carrying out a valuation of land holdings and land use of peasants;
- carry out a valuation of the lands of settlements;
- calculate losses when land is removed from agricultural use or soil is damaged.

Scientists have proven that when the natural potential of agricultural land is reduced, the issue of sustainable development of land use becomes acute, this threat is greater than environmental problems.

For the development of sustainable agriculture, it is necessary to develop structural changes and implement the latest ecologically safe technologies that will reduce the burden on land resources. Because the modern conduct of agrarian business in Ukraine inhibits the greening of agrarian land use. The implementation of production mechanisms that will contribute to the environmentalization of agricultural production will provide an opportunity for the appearance of ecological goods and the improvement of the ecological situation in Ukraine.

A very positive start for changes in the agricultural sector are the ideas specified in the Strategy of Sustainable Development of Ukraine until 2030. They consist in the fact that it is planned to increase the area of agricultural

land for organic agar production in the period until 2030 to 3 million hectares and to increase the volume of organic agricultural products by at least 5% [8].

It should be taken into account that a mandatory condition for the development of sustainable agricultural land use is control by the state. After all, it is the state control over the use and protection of land that is the guarantee of the implementation of the principles for the sustainable development of agricultural enterprises. It is necessary to implement measures of economic stimulation, increase responsibility for violations of environmental legislation.

– The main areas that can be used for the development of sustainable land use are:

- rational use of agricultural land by agrarian business entities;
- environmentalization of agrarian business;
- increase the control and responsibility of land owners and users for the deterioration of land resources;
- introduction of new ecologically safe technologies of conducting agar business;
- implementation of measures to increase soil fertility;
- prohibition of the use of degraded and unproductive lands for agricultural purposes;

- strengthening of state control over the rational use of agricultural land and ensuring soil protection;
- development of a legal framework that will promote sustainable land use;
- the need to combine the interests of farm owners and society regarding sustainable land use;
- application of international experience of sustainable land use.

Having familiarized ourselves with the above directions, we can say that their complex application will allow us to move to the development of sustainable agriculture.

Conclusions and suggestions

Preservation of land resources is a priority for both executive and local self-government bodies. However, in economic circles, land resources are perceived mainly as an endless reservoir of food and raw materials for industry. Ignoring the universal laws of nature and its innate capacity for self-regeneration has led to unbalanced land use that has caused its degradation.

Therefore, there is a need to develop policies and practices that promote sustainable land management, including the development of monitoring methods and warning indicators for land degradation.

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