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# ORGANIC AGRICULTURE AS AN ELEMENT OF SOIL PRESERVATION AND RESTORATION

***O.O. ALIEKSIEIEV,*** *candidate of Agricultural Sciences, Vinnytsia National Agrarian University*
***O.I. VRADII,*** *candidate of Agricultural Sciences, Vinnytsia National Agrarian University*

*The materials of the article are based on the study of the positive impact of organic farming on the reproduction and preservation of soils. The research methodology is based on a systematic approach and a dialectical method of understanding the organic principles of land use in agricultural production, taking into account retrospective analysis, monographic method, methods of synthesis and analysis. The essence of the system of organic farming from the point of view of ensuring balanced land use is revealed. It is shown the dynamics of land distribution by areas in Ukraine for 2018-2022, characterizing by an extremely high rate of agricultural development, which significantly exceeds the ecologically justified limits, as well as the distribution of soil areas of Ukraine by humus content. Organic fertilizers, plant residues, by-products, green manure, etc. remain the most important resource for soil humus reproduction, the application of which has a positive effect on the agrochemical, physical and water-air properties of soils. The structure of mineral and organic fertilizers application in 1994-2022 is given. The main problems of agricultural land use are highlighted. Under modern conditions of agricultural production and existing land use systems, it is impossible to achieve even a simple reproduction of soil fertility without a significant improvement of mechanisms for controlling their use by the state, as well as the introduction of more effective, mostly economic, mechanisms to support soil protection measures. International experience shows that new information technologies, in addition to traditional research methods, will provide effective control of land use and soil protection at different spatial levels, from the state to a specific field. The mechanism of preservation and reproduction of soil fertility in the system of organic farming is proposed for use by agricultural commodity producers. It includes a set ofmeasures aimed at restoring stocks of organic substances and improving agro physical properties of soil. The state support in solving problematic issues is also important.It is recommended to supplement the developed mechanism with such components as legal, scientific and technical, economic, financial, scientific and educationalsupports.*

***Key words:*** *biological farming, soil, plowed land, structure of sown areas,reproduction and preservation of soils, organic agriculture.*
***Fig. 4. Ref. 10.***

**Introduction.** The problem of monitoring the condition of soils in Ukraine is not given due attention. It concerns the scientific field, where full-fledged studies on the spread, causes and ways to eliminate degradation are not carried out due to insufficient funding. It also concerns the legislative and executive authorities, where no effective control measures have been developed. In general, the society has not created an atmosphere of maximum support for the preservation of soil cover as an irreplaceable national heritage. Mass media and educational institutions are indifferent to this problem. That is why these issues require an immediate solution, namely, the development of an effective mechanism of soil reproduction and preservation, taking into account the system of organic farming, which has attracted

considerable interest not only from scientists, but also from practitioners in recent years. Soil cover is one of the main components of the environment, which performs vital biospheric functions. Soil and plant cover in nature form a single system. Soils regulate the quality of surface and underground waters, the composition of atmospheric air; they are the habitat of most living organisms on the land surface and provide a favorable environment for humans. They are also the main source of agricultural production. The loss of soil fertility, its degradation deprives plants of the ecological foundations of their existence. Therefore, the restoration of the fertility of degraded soils is the restoration of the natural ecological balance of areas disturbed by humans as a result of irrational economic activity.

Over the last century, undesirable processes in the structure and functioning of many ecosystems occurred on the territory of Ukraine. Such important complexes of nature as forest massifs, biologically clean water and air, numerous species of plants and animals, etc. were destroyed. Reckless human actions have led to the violation and irreparable loss of the qualitative characteristics of soils. The loss of humus, which serves not only as the bioenergetic basis of fertility, but also acts as a regulator of all processes in the soil, is of great concern. This is evidenced by the fact that in Ukraine, due to water and wind erosion, an average of 600-700 kg/ha of humus is lost. The same amount of humus and more is lost through the removal of agricultural crops.

Ukrainian black top soils make up 9% of world reserves and 30% of European reserves. In general, there are up to 300 million hectares of soils of this type in the world. About 24 million hectares are used in Ukraine. However, the quality of Ukrainian black soils is steadily declining. The decrease in the content of humus in the arable horizon is influenced by:

- Strengthening of humus mineralization as a result of increasing the intensity of tillage.
- Unreasonable deepening of the arable layer.
- Insufficient input of crop residues and organic fertilizers into the soil.
- Application of high rates of mineral fertilizers, not balanced in composition.
- Stubble burning.
- Strengthening of water erosion and deflation processes.
- Change in the structure of sown areas in the direction of increasing the share of row crops.

Unfortunately, the problem of monitoring the condition of soils in Ukraine is not given due attention. It concerns the scientific field, where full-fledged studies on the spread, causes and ways to eliminate degradation are not carried out due to insufficient funding. It also concerns the legislative and executive authorities, where no effective control measures have been developed. In general, the society has not created an atmosphere of maximum support for the preservation of soil cover as an irreplaceable national asset. Mass media and educational institutions are indifferent to this problem. That is why these issues require an immediate solution, namely, the development of an effective mechanism of soil reproduction and preservation, taking

into account the system of organic farming, which has attracted considerable interest not only from scientists, but also from practitioners in recent years.

**Statement of the problem.** The problem of rational use of land resources of Ukraine has long been the focus of research for many domestic scientists like O. Hutorov, D. Dobriak, L.Novakovskyi, P. Sabluk, M. Stupen, A. Tretiak and others.

The scientific foundations of the theory and practice of organic land use are presented in the works of S. Antonets, M. Pysarenko, V. Artysh, M. Kapshtyk, O.Shkuratov, D. Crowder, J. Reganold, K. Mondelaers and others. Taking into account the significant scientific contribution of the above-mentioned scientists in the development of sustainable land use and organic agriculture, the current realities of agricultural use of land resources require the continuation of scientific research to increase the level of introduction of organic methods of agricultural production into the domestic practice of management in order to improve the socio-economic and ecological balance of land use.

**The purpose of the article** is to reveal the essence of the system of organic farming in terms of ensuring balanced land use.

**Research methodology.** The materials of the article are based on the study of the positive impact of organic agriculture on the reproduction and preservation of soils. The research methodology was based on a systematic approach and a dialectical method of learning organic principles of land use in agricultural production, taking into account retrospective analysis, monographic method, methods of synthesis and analysis as well.

**Summary of research results.** Ecological is one of the strategic imperatives of the development of the agrarian sector of Ukrainian economy, which is aimed at reproduction, protection and increase of soil fertility. Taking into account the Concept of balanced (sustainable) development of agro ecosystems in Ukraine for the period until 2025 and the Strategy of balanced use, reproduction and management of soil resources of Ukraine, the following directions of sustainable development are defined in the National Paradigm of Sustainable Development of Ukraine: preservation, reproduction and rational use of biological diversity in agricultural landscapes; formation of zonal competitive resource- and energy-saving models of efficient management of agricultural production on the basis of environmental protection organization of the territory, reproduction of natural resource potential; improvement of the structure of sown areas and crop rotation for fuller use of bioclimatic potential, improvement of the phytosanitary condition of the soil and agrophytocenosis, maintenance of the optimal balance of organic matter and biological condition of the soil; the use of soil-protecting energy-saving cultivation technologies that ensure optimization of its agro physical properties and increase of anti-erosion resistance, especially in regions of erosion and deflation [1, 2].

According to economic use as of January 1, 2022 the country's land fund was structurally distributed as follows: a significant share of the land area (68.7%) is agricultural land consisting of arable land (78.4%), pasture fields (13.1%), hayfields (5.8%), perennial plantations (2.2%) and fallow land (0.5%). Forests and other

wooded areas occupy 15.6% of the country's territory, built-up areas occupy 6.0%, the areas covered by surface water occupy 4.0% and other areas occupy 5.7%.

According to the data of the State Geocadastre of Ukraine for 2022, compared to 2021, the structure of the land fund changed in terms of the main types of land, in particular, the area of agricultural land decreased by 15.6 thousand hectares. The dynamics of changes in the structure of the land fund of Ukraine by the main types of areas and economic activity for 2018–2022 are presented in the diagram (Fig. 1), which characterizes minor changes in the distribution of land.

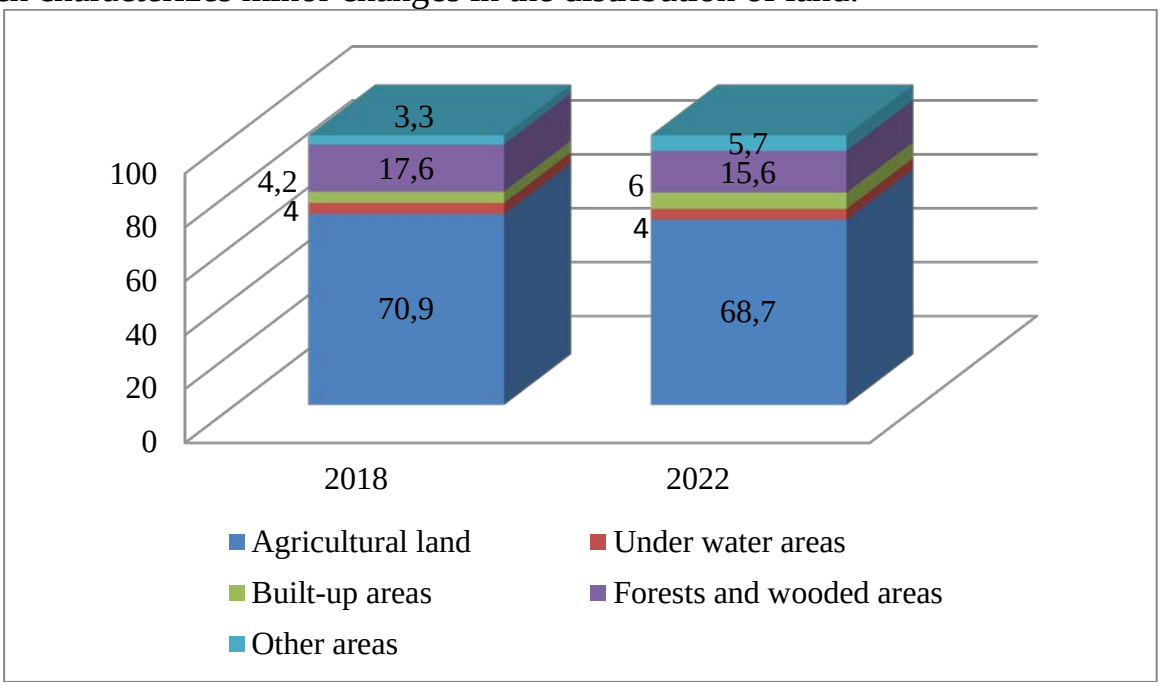


Fig. 1. Dynamics of land distribution in Ukraine by areas for 2018–2022
*source: formed on the basis of own research*

Thus, the territory of Ukraine is characterized by an extremely high indicator of agricultural development, which significantly exceeds ecologically reasonable limits.

Today the information on the state of soil fertility in Ukraine is formed through soil monitoring, the main component of which is the survey of agricultural land. It is carried out by the state institution "Institute of Soil Protection of Ukraine" ("State Soil Protection") authorized by the Ministry of Agrarian Policy.

Examinations are carried out cyclically every 5 years. Corresponding changes in the qualitative state of soils are recorded not annually, but in five-year periods (rounds) [3]. According to the data of the 10th survey round (2018-2022), the weighted average content of humus in the soils of Ukraine is 3.16% against 3.14% in the 10th round (2011-2017). The largest areas are occupied by soils with medium and increased humus content (61.9%). The soils with high and very high humus content occupy 22.8% of areas, while the soils with very low and low humus content occupy 15.4% of areas (Fig. 2).

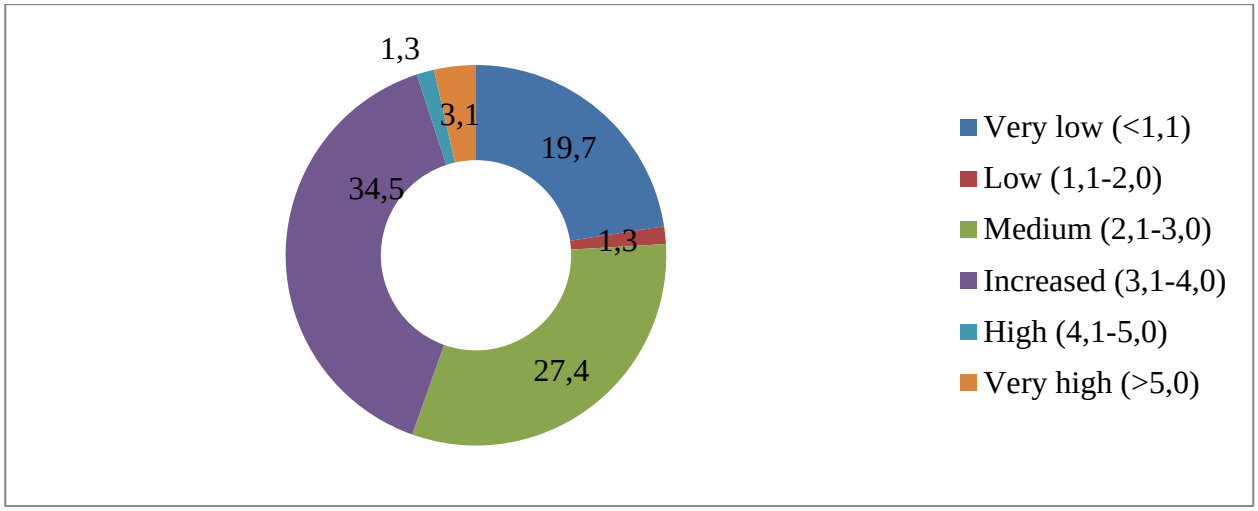


Fig. 2. Distribution of soil areas of Ukraine by humus content (2018-2022), %
*source: formed on the basis of own research*

The removal of humus by certain crops (corn, sugar beets, potatoes, sunflower, etc.) is 2.0-2.5 t/ha, which is by three or four times higher than the average value of its removal by other agricultural crops (winter wheat, barley, rye, buckwheat, etc.). To compensate for these humus losses, it is necessary to add 40-50 t/ha of organic fertilizers = (2 t/ha:0.05), (2.5 t/ha:0.05) to the soil annually, which there is a shortage in economic entities due to a decrease in the number of livestock to one head per 100 hectares of agricultural land [5]. This requires urgent effective protection of the soil cover from its depletion in humus content. This is also important because Ukraine's entry into the European Economic Area requires the formation of an environmental policy for the branches of the national economy, as well as cleaner production in order to create prerequisites and ensure their functioning based on the principles of sustainability of the biosphere as a whole system. Organic fertilizers, plant residues, by-products, green manure, etc. remain the most important resource for soil humus reproduction, the application of which has a positive effect on the agrochemical, physical and water-air properties of soils.

Compared to mineral fertilizers, the volumes of organic fertilizers are insignificant and amounted to only 0.5 t/ha of cultivated area in 2022 (Fig. 3), while the minimum rate to ensure a deficit-free balance of humus should be from 8 up to 14 t/ha (depending on the soil and climate zone).

We agree with the opinion of Ye. Skorokhod that the main problems of agricultural land use in Ukraine are:

- high economically and ecologically unjustified level of economic use of territories;
- excessive plowing of land, which is 70% and 88-90% only in some regions of Ukraine;
- a large part of the land is under intensive cultivation;
- expansion of arable land due to slopes, unproductive, degraded and floodplain lands, which led to adverse consequences of man-made load on the soil cover;

- humus losses amount to 0.7 t/ha, and in 25 years the humus content has decreased by 25% due to the destruction of the arable layer of the soil, the destruction of the hydrographic network, the disappearance of small rivers and the siltation of natural and artificial reservoirs;

- violation of the structure and chemical composition of soils;

- loss of nutrients, as a result of the fact that more than 100 kg/ha of nutrients are removed in the process of harvesting, they are not returned to the soil with fertilizers;

- emissions of greenhouse gases by agricultural land, which contribute to the formation of the “greenhouse effect” [6].

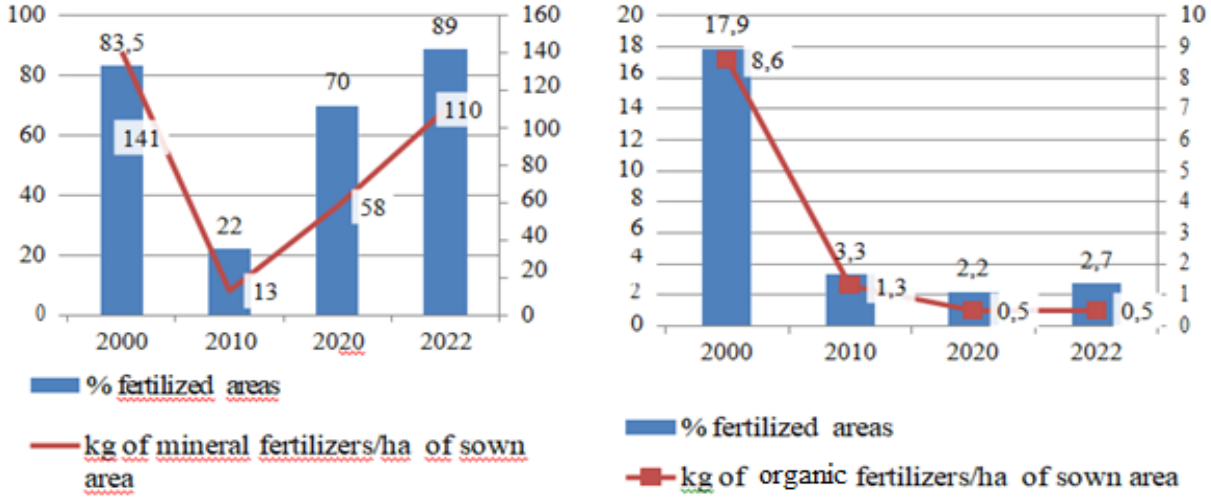


Fig. 3. Structure of application of mineral and organic fertilizers in Ukraine, 2000-2022

*source: formed on the basis of own research*

All of the above shows that under modern conditions of agricultural production and existing land use systems, it is impossible to achieve even a simple reproduction of soil fertility without a significant improvement of mechanisms for controlling their use by the state, as well as the introduction of more effective, mostly economic, mechanisms to support soil protection measures. International experience shows that new information technologies, in addition to traditional research methods, will provide effective control of land use and soil protection at different spatial levels, from the state to a specific field.

According to Ye. Mylovanov, it is quite possible to correct the situation in the field of agricultural land use in Ukraine by implementing such agro-production systems, which are based on the consideration of the ecological balance in the use of land resources from the very beginning. The international experience of the rational use of land indicates an extremely high potential for the implementation of organic farming methods, which are aimed at maintaining a balance between ecological and economic expediency and social justice. The numerous advantages of organic methods, proven by many years of farming practice all over the world, can

significantly improve the balance of land use and ensure the sustainable development of Ukrainian society in the future [7].

Biological agriculture, which is also called organic, involves the rejection of the use of chemicals not only for the production of crops, but also for the reproduction of soil fertility. Taking into account the latter, the agriculture, in which the production of crops and the reproduction of soil fertility are ensured by the minimal use of chemical means of production, can be called biological.

According to the definition of International Federation of Organic Agricultural Movement (IFOAM), organic farming is the farming that guarantees ecologically, socially and economically expedient production of crops. According to the representatives of this federation, organic farming has future and a perspective thanks to the fact that in order to obtain crops it uses natural processes, which have existed for millions of years, as well as have created the soil and everything living on the Earth. Such farming is based on the environmentally sound use of natural soil fertility as a key element of successful production and the natural potential of plants and landscapes; such farming is aimed at harmonizing agricultural practices with the environment. Organic or biological farming significantly reduces the use of external factors of production and resources due to the limitation of the use of chemically synthesized fertilizers and pesticides and the wide use of natural factors.

Optimizing the structure of sown areas is of particular importance in biological or organic farming, so that it would be possible to ensure the crop rotation in the rotation of agricultural crops with any specialization of the crop sector in the economy. When this classical principle of crop rotation is not maintained, the very prospect of transitioning the farm to biological agriculture becomes unrealistic. After all, even if the crop is grown in only one field using the technology of repeated sowing (the crop is grown in one field of crop rotation for two or more years), then using chemical means of protecting plants from weeds or diseases and pests cannot be avoided, because the damage from the latter in this case can be significant, reaching half or even more of the crop [8]. As R. Panas points out, it is possible to improve the balance of humus and nutrients in farming by introducing soil conservation crop rotations with an optimal ratio of crops into the production, as well as by expanding the areas under perennial grasses, especially legumes, by growing intermediate crops and green manure crops, by replacing clean fallows with engaged ones and by using organic-mineral fertilizers (OMF) obtained on the basis of livestock and poultry waste, peat, lignin, etc. [9].

Biological farming will have the right to exist only if it ensures full reproduction of fertility, an integral indicator of which is the humus state of the soil. It is possible to maintain natural fertility only with positive humus balance even without the use of mineral fertilizers [10]..

In addition to manure and compost, the post-harvest residues of agricultural crops and their non-marketable products in the form of straw or stalks and the mass of green manure crops are the main sources of organic matter entering the soil under both traditional and biological or organic farming systems. The oxidation of humus

by microorganisms to mineral compounds is an expendable item in its balance. The latter will be facilitated not only by excessive loosening of the soil, but also by limited entry of fresh organic matter into the soil environment as energy for humus formation.

Considering the above mentioned, it is advisable to offer a mechanism for preserving and reproducing soil fertility in the organic farming system (Fig. 4) for use by agricultural producers, which will include:

- development and observance of a rational structure of sown areas and an effective crop rotation system;
- providing sufficient biomass in the soil ecosystem, including destruction of nutrient residues with accumulation in the arable layer of the soil;
- unification of production processes in plant cultivation and animal husbandry;
- mulching;
- control of sufficient amount of N, P, K and other nutrients in the soil;
- seed biotreatment (reduction of chemical load);
- composting;
- selection of varieties and hybrids of agricultural crops;
- application of the grass rotation system, which will include agro-ecological optimization of land management and zoning of agricultural lands, the species structure of crops, the use of high-yielding varieties and hybrids resistant to diseases, pests and unfavourable soil and climatic conditions, use of soil protective and phytoremedial properties of various types of plants, construction of highly productive ecological sustainable agrocenoses and agroecosystems;
- reducing the frequency and intensity of tillage;
- use of safe organic fertilizers, green manure crops, manure, bio-additives and microbial inoculants.

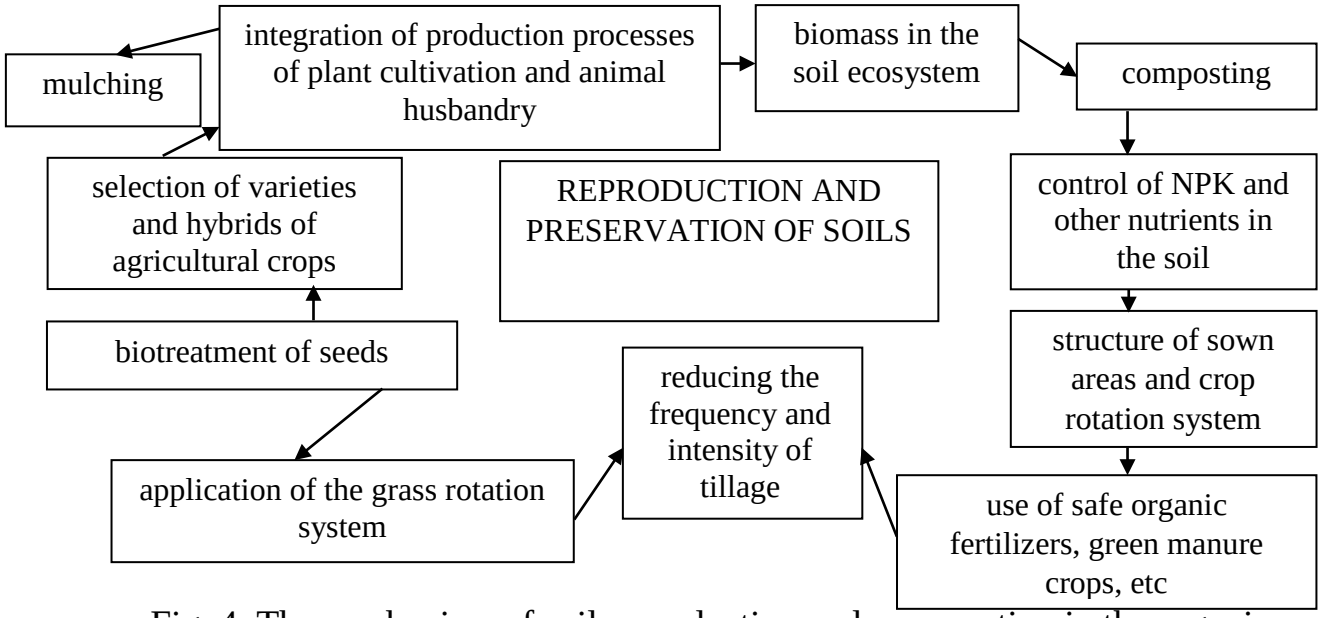


Fig. 4. The mechanism of soil reproduction and preservation in the organic farming system

*source: formed on the basis of own research*

These measures will contribute to the restoration of reserves of organic substances and improve the agrophysical properties of the soil. The state support in solving the raised problematic issues is also important. Therefore, we consider it necessary to supplement the above-mentioned mechanism with the following items:

- regulatory and legal support, which is extremely important especially in the modern conditions of private property and lease relationships: compliance with current legislative acts aimed at implementing the Land Code of Ukraine, the Law of Ukraine on Land Protection, the Law of Ukraine on State Control over Land Use and Protection, the Law of Ukraine on Land Management, as well as a number of resolutions of the Cabinet of Ministers of Ukraine and the Verkhovna Rada of Ukraine;
- scientific and technical support: improvement of the system of monitoring the qualitative state of soils and prevention of the spread of degradation processes;
- economic support in terms of stimulating landowners and land users for ecologically safe use of soils and increased responsibility for maintaining fertility;
- financial support: determination of the purpose, conditions, forms and methods of state funding; formation of an algorithm for monitoring the degree of achievement of goals and the use of allocated funds;
- scientific and educational support.

**Conclusions.** Organic agriculture through balanced land use increases the reliability and sustainability of modern agricultural systems. All the proposed methods and techniques of organic farming improve the physical and chemical properties of the soil, namely:

- increase nutrient reserves;
- improve absorption capacity, moisture capacity and moisture permeability;
- enrich with microflora;
- improve the biological activity and physical state of the soil.

The constant care for the protection of the soil, its structure and properties, as well as the implementation of a system of measures to increase fertility are the most important conditions for the preservation of the biosphere, normal plant cover and productivity of agriculture. Such countries as the USA, Germany, France, Canada and China have already understood that the protection of soils, the fight against their degradation and pollution can be effectively carried out only at the state level. The key principle of foreign legislation is the inadmissibility of such action on the soil, which leads to deterioration of its quality, to its degradation, pollution and destruction.

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## *АНОТАЦІЯ*

## *ОРГАНІЧНЕ ЗЕМЛЕРОБСТВО, ЯК ЕЛЕМЕНТ ЗБЕРЕЖЕННЯ ТА ВІДНОВЛЕННЯ ҐРУНТІВ*

*Матеріали статті базуються на дослідженні позитивного впливу органічного землеробства на відтворення та збереження ґрунтів. В основу методології дослідження покладено системний підхід та діалектичний метод розуміння органічних засад землекористування в сільськогосподарському виробництві з урахуванням ретроспективного аналізу, монографічного методу, методів узагальнення та аналізу. Сутність системи органічного землеробства від розкривається точка зору забезпечення збалансованого землекористування. Показано динаміку розміщення земель України за угіддями за 2018-2022 рр., яка характеризується надзвичайно високими темпами освоєння сільського господарства, що значно перевищує екологічно обґрунтовані межі, а також розподіл площ ґрунтів України за вмістом гумусу. Найважливішим ресурсом для відтворення ґрунтового гумусу залишаються органічні добрива, рослинні рештки, побічна продукція, сидерати тощо, внесення яких позитивно впливає на агрохімічні, фізичні та водно-повітряні властивості ґрунтів. Наведено структуру внесення мінеральних та органічних добрив у 1994-2022 рр. Висвітлено основні проблеми сільськогосподарського землекористування. За сучасних умов ведення сільськогосподарського виробництва та існуючих систем землекористування неможливо досягти навіть простого відтворення родючості ґрунтів без*

*суттєвого вдосконалення механізмів контролю за їх використанням з боку держави, а також запровадження більш ефективних, переважно економічних, механізмів підтримувати ґрунтозахисні заходи. Міжнародний досвід показує, що нові інформаційні технології, крім традиційних методів дослідження, забезпечать ефективний контроль землекористування та охорони ґрунтів на різних просторових рівнях – від державного до конкретного поля. Запропоновано для використання сільськогосподарськими товаровиробниками механізм збереження та відтворення родючості ґрунтів у системі органічного землеробства, який включає комплекс заходів, спрямованих на відновлення запасів органічної речовини та покращення агрофізичних властивостей ґрунту. Не менш важливою є державна підтримка у вирішенні проблемних питань, розроблений механізм рекомендовано доповнити такими складовими як: правове, науково-технічне, економічне, фінансове, науково-освітнє забезпечення.*

***Ключові слова:*** *біологічне землеробство, ґрунт, розораність земель, структура посівних площ, відтворення і збереження ґрунтів, органічне сільське господарство.*

***Рис. 4. Літ. 10.***

## Інформація про автора

**Алєксєєв Олексій Олександрович** – кандидат сільськогосподарських наук, доцент кафедри екології та охорони навколишнього середовища Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна, 3, e-mail: alekseev_oleksiy@ukr.net).

**Врадій Оксана Ігорівна** – кандидат сільськогосподарських наук, асистент кафедри екології та охорони навколишнього середовища Вінницького національного аграрного університету, (21008, м. Вінниця, вул. Сонячна, 3, e-mail: oksanavradii@gmail.com).

**Alieksieiev Oleksii Oleksandrovych** – Candidate of Agricultural Sciences, Associate Professor of the Department of Ecology and Environmental Protection of Vinnytsia National Agrarian University (21008, Vinnytsia, Soniachna Str. 3, e-mail: alekseev_oleksiy@ukr.net).

**Vradiy Oksana Ihorivna** – Candidate of Agricultural Sciences, Assistant of the Department of Ecology and Environmental Protection, Vinnytsia National Agrarian University (21008, Vinnytsia, 3, Soniachna St., e-mail: oksanavradii@gmail.com).