

## ECOLOGICAL ASPECTS OF THE ANALYSIS OF THE ACTIVITY OF THE ORGANIC FORM ENTERPRISE OF THE EASTERN OPILLIA

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It is considered the importance of the process of greening as a direction of agricultural development, which is based on the mastering of ecological management methods, provides expanded reproduction of natural and anthropogenic resources due to the formation of sustainable ecological and economic systems, aimed at increasing the volume of production of competitive products through the creation of a sustainable agricultural landscape using ecological management methods on the basis of the introduction of adaptive landscape farming systems, rational involvement in the economic turnover and increasing the efficiency of the use of natural, material and labor resources of the countryside. In addition, quite often the completely careless use of natural resources, the use of extensive resource-intensive technologies, the low level of environmental awareness of society cause irrational use of nature and, ultimately, lead to significant environmental degradation and a decrease in the production of high-quality and environmentally safe products at domestic agro-industrial enterprises. The article researches ecological farming farms that are based on the use of purely organic fertilizers, methods of non-chemical control of the spread of weeds, pests, diseases, storage of food and feed without synthetic additives; rely on advanced technologies, guarantee the high quality of food products, economically and efficiently use land resources, maintain the natural balance in agricultural land use. Theoretical justifications were considered and practical recommendations aimed at improving the formation of the system of environmentally safe agricultural land use were proposed. In order to ensure the balanced development of agroecosystems and rational nature management, the transition of the agricultural sector to alternative farming methods is of great importance. The organisation of the agricultural territory is the first stage on the way of the transformation of the natural ecosystem into an agroecosystem, and the boundaries of the types of organisation of the agricultural territory form the natural borders of agroecosystems.

The study of the ecological state of natural resources was bases of agricultural organic forms enterprises of the eastern Opillia region, namely the agro-ecosystem of farms of the bioorganic method of management and the impact on ecosystems in the territory of the Berezhany region (Research of agro-ecosystems in the LLC "Zhyva Zemliah Potutory" (organic method of farming) village Potutory, Ternopil region. The goal is to substantiate ecological approaches and analyze practical recommendations for the formation of a mechanism for the development of environmentally safe agriculture and the provision of an ecological assessment of agricultural landscapes for the possibility of organic cultivation of agricultural crops. Materials and methods of determination were carried out in accordance with the methodology of continuous soil and agrochemical monitoring of agricultural lands of Ukraine.

Farmers of alternative farms, in most cases, cannot compete with farmers of traditional farms in terms of the amount of harvest. Satisfactory yield is entirely dependent on the amount of manure and compost used, as well as the area that farmers can devote to leguminous crops. *Key words:* agroecosystem, biologization, agrochemicals, assimilation nitrogen, organic fertilizers, green manures, biological products.

**Екологічні аспекти аналізу діяльності підприємства органічної форми господарювання східного регіону Опілля.  
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Розглянуто важливість процесу екологізації як напрямку розвитку сільського господарства, що базується на освоєні екологічних методів господарювання, забезпечує розширене відтворення природних і антропогенних ресурсів за рахунок формування стійких еколого-економічних систем, спрямованих на збільшення обсягів виробництва конкурентоспроможної продукції через створення стійкого агроландшафту за використання екологічних методів господарювання на основі впровадження адаптивно-ландшафтних систем землеробства, раціонального залучення до господарського обороту і підвищення ефективності використання природних, матеріальних і трудових ресурсів сільської місцевості. Крім того, досить часто абсолютно неконтрольоване використання природних ресурсів, застосування екстенсивних ресурсомістких технологій, низький рівень екологічної свідомості суспільства причиняють нераціональне природокористування і, зрештою, призводять до значної деградації довкілля та зниження обсягів виробництва високоякісної і екологічно безпечної продукції на вітчизняних агропромислових підприємствах. У статті проведено дослідження фермерських господарств екологічного землеробства, які базуються на використанні суто органічних добрив, методах нехімічного контролю за поширенням бур'янів, шкідників, хвороб, зберіганні продуктів харчування і кормів без синтетичних добавок; спираються на передові технології, гарантують високу якість продуктів харчування, економно та ефективно використовують ресурси землі, підтримують природний баланс в аграрному землекористуванні. Розглянуто теоретичні обґрунтування та запропоновано практичні рекомендації, що спрямовані на удосконалення формування системи екобезпечного сільськогосподарського землекористування. З метою забезпечення збалансо-

ваного розвитку агроєкосистем та раціонального природокористування важливе значення має перехід аграрного сектора на альтернативні методи господарювання. Організація сільськогосподарської території є першим етапом на шляху перетворення природної екосистеми в агроєкосистему, а межі типів організації сільськогосподарської території формують природні кордони агроєкосистем. Базою виконання роботи вибрано дослідження екологічного стану природних ресурсів сільськогосподарських підприємств органічних форм господарювання східного регіону Опілля, а саме агроєкосистема господарств біоорганічного методу господарювання і впливу на екосистеми на території Бережанського регіону ( Дослідження агроєкосистем у ТЗОВ «Жива земля Потутори» (органічний метод землеробства) с. Потутори, Тернопільського району. Метою є обґрунтування екологічних підходів та аналіз практичних рекомендацій щодо формування механізму розвитку екобезпечного землеробства та надання екологічної оцінки агроландшафтів для можливості органічного вирощування сільськогосподарських культур. Матеріали і методи визначення проводили згідно з методикою суцільного ґрунтово–агрохімічного моніторингу сільськогосподарських угідь України. *Ключові слова:* агроєкосистема, біологізація, агрохімікати, асиміляційний азот, органічні добрива, сидерати, біопрепарати.

**Problem statement.** Organic agriculture must be based on the principles of natural ecological systems and cycles, working with, coexisting with, and supporting them. The results are achieved by greening the production environment. For example, for plants it is living soil, for animals it is a farm ecosystem, for fish and marine organisms it is an aquatic environment. The principles of organic farming, grazing, and the use of natural systems in the wild that are used to produce crops must exist in balance and in natural cycles. It is well known that the application of mineral fertilizers significantly increases the productivity of agricultural crops, but the use of organic fertilizers has a positive effect on the quality and restoration of soil fertility.

The use of leguminous crops in crop rotations allows solving the issue of providing fodder for livestock and organic fertilizers for crop production [1]. The study of agrochemical indicators of soils due to the introduction of alternative fertilizers is a necessity for conducting scientific research in this direction [2; 3]. The factors studied in the observations have a tangible impact on the formation of positive agrochemical indicators of soil quality. Producers, processors, traders, consumers of organic products must protect and protect the environment, including landscapes, climate, habitat, biological diversity, air and water. The role of organic agriculture in farming, processing, distribution, and consumption is to support and improve the health of ecosystems and organisms, from the simplest in the soil to humans. According to this principle, the use of fertilizers, pesticides, veterinary drugs for animals and food additives that can have a negative effect on health should be avoided [4].

**The relation of the authors' work with important scientific and practical tasks.** One of the directions of this research is the theoretical substantiation and development of practical recommendations aimed at improving the formation of the system of environmentally safe agricultural land use. An approach to the evaluation of the ecological efficiency of organic farming activities, which, in contrast to the existing traditional ones, provides for: a) long-term ecological stability; b) preservation and reproduction of soil fertility; c) rational use of water resources; d) conservation of biodiversity; e) refusal to use genetically modified organisms (GMOs); e) maintenance of ecological balance in the agroecosystem and its assimilation capabi-

lities [4,5,6]. Making a decision on the transition to an ecologically oriented vector of development is possible only if there is confidence in the ecological expediency and interest in the usefulness of one's business.

**Survey of recent research and publications.** The basis of the Ukrainian legislation that regulates the "organic" sphere is the law "On the production and circulation of organic agricultural products and raw materials", which supposedly prohibits the use of fertilizers and pesticides, but allows a whole list of exceptions. Without exception, only mineral nitrogen fertilizers are prohibited. Moreover, there is an organization in Ukraine that certifies fertilizers and plant protection products for organic farming. That is, not every "organic" product, which is sold 2-5 times more expensive than the usual one, was really grown without fertilizers and pesticides [5]. Studying the experience of conducting ecological agriculture in European countries, it is necessary to single out the common reasons for the interest of enterprises in the transition to alternative production.

First of all they are caused by the possibility of conducting ecological management methods, which ensures the expanding reproduction of natural and anthropogenic resources due to the formation of sustainable ecological and economic systems, aimed at increasing the volume of production of competitive products through the creation of a sustainable agricultural landscape using ecological management methods based on the introduction of adaptive landscape systems agriculture, rational involvement in economic turnover and increasing the efficiency of the use of natural, material and labor resources in rural areas [6; 7]. Researchers believe that the development of agroholdings will have negative social and environmental consequences in the future, because their export orientation, aimed at obtaining quick profits, leads to a violation of crop rotation and thus to the degradation of agricultural land, a reduction in fodder crops, and the abandonment of animal husbandry [6; 7].

The reason of a number of environmental problems caused by agriculture is the excessive use of chemicals, primarily mineral fertilizers and chemical plant protection agents. Taking into account the above, the policy of regulation in the field of chemicalization of agricultural production should be aimed not only at maximizing the volume of agricultural production, but also necessarily at encouraging the preservation and restoration of soil

fertility, the introduction of innovative technologies and techniques, developments and achievements of science in the field of ecologically safe agriculture.

The intentions of the Ukrainian state to comprehensively support ecological entrepreneurship are manifested primarily in the adopted legal acts. First of all, these are Articles 3, 16, 50 of the Constitution of Ukraine, the Law of Ukraine "Basic Principles (Strategy) of State Environmental Policy for the Period Until 2030". In particular, the specified law stipulates that within the framework of the implementation of the Central Development Strategy until 2030, it is envisaged to unite the efforts of the state, enterprises and the population in solving the following issues: overcoming military aggression by Russia and reintegration of the occupied territories; reduction of environmental pollution; decrease in the level of diseases, increase in the average life expectancy of a person; reduction of energy and resource intensity of products; formation of a developed system of renewable energy sources; increasing the efficiency of national energy and resource saving programs; creation of a positive environmental image of Ukraine for effective promotion of the country in the international space and integration into world society; production of ecological products (organic products) to ensure food security, public health and sustainable economic development [8-9].

**Highlighting previously unsolved parts of the general problem, to which the specified article is devoted.** In this article, research was conducted on the causes of a number of environmental problems caused by agriculture, including excessive use of chemicals, primarily mineral fertilizers and chemical plant protection agents. Taking into account the above, the policy of regulation in the field of chemicalization of agricultural production should be aimed not only at maximizing the volume of agricultural production, but also necessarily at encouraging the preservation and restoration of soil fertility, the introduction of innovative technologies and techniques, developments and achievements of science in the field of ecologically safe agriculture.

**Novelty.** We offered to the investigated farms alternative ways of enriching the soil with nitrogen. An analysis of the technology of accelerated compost production was carried out. Depending on the substrate, the NPK content in compost can be within 1.35; 0.57; 0.97, it has a dark color. Noteworthy is the change in the smell of the compost material – from stinky to the "smell of the earth" caused by the products of actinomycetes.

**Methodological or general scientific value.** The importance of alternative methods of restoring fertile soil layers is determined, namely, with the help of modern organic fertilizers and microbiological preparations, it is possible to build an optimal system of nitrogen nutrition during organic production, with the aim of using it as a component of organic farming. The purpose of the definition is the substantiation of ecological approaches and the analysis of practical recommendations for the formation of a mechanism for

the development of environmentally safe agriculture; the degree of violation of the ecological balance in the balance of humus and basic nutrients and the ecological and agrochemical state of the lands of intensive agricultural use in the eastern region of Opillia. The research was conducted by processing the materials of the State Statistics Service in Ukraine [10-11]. The indicators of the structure of agricultural land in non-traditional farms, the structure of sown areas, the amount of organic and mineral fertilizers, and the spread of soil degradation processes were analyzed.

**Statement of basic article.** Alternative production should be considered as a priority for the development of ecologically oriented entrepreneurship in Ukraine. First of all, we are talking about organic production of agricultural products, the experience of which confirms the formation of a positive effect for all participants in this process. Along with the production of organic food products in Ukraine, the production of the necessary technological elements is developing: organic seeds, permitted by the standards of organic production of plant protection products, biological preparations for combating pests and diseases of plants and animals, feed and feed additives [12]. Research on agroecosystems at the "Zhyva Zemlia of Potutory" LLP (organic farming method) 300 hectares of land, of which 200 are arable, 34 dairy cows, a garden with vegetables and herbs – 15 people take care of this farm, two of them are Swiss (Elias de Boer and Christina Lieberger). Besides following the principles of organic production, they also apply the system of biodynamic agriculture, which was developed by the Austrian mystic philosopher Rudolf Steiner, known in particular as the creator of Waldorf pedagogy. From a worldview, biodynamic agriculture involves perceiving the farm as a whole organism, treating the soil as living, and using natural, specially made materials for working with soil, compost, and plants. Christina Lieberger in Switzerland taught horticulture at a Waldorf school, and in Potutory she supervises the field of herb cultivation. Biodynamic agriculture in the cultivation of herbs consists in using compost and a lot of manual labor [13-14].

According to the results of the observations, an ecological assessment of the condition of the soils of the agricultural enterprises of Zhyva Zemlia Potutory LLC was carried out. Potutory, Berezhany district and LLC "Agroprodservice" Ternopil region. Judging from the data on two farms, the following can be said: the content of alkaline hydrolyzed nitrogen is at a low level, because the nitrogen of mineral fertilizers is almost completely lost in the year of its application, this element is the most important element, as the basis of all living organisms, the doses of nitrogen application in general, on farms humus content of 2.41% and 2.73%, respectively, is average. Soils with a soil solution reaction ranging from weakly acidic to neutral are widespread on the territory of the studied farms. Acidity indicator (Potutory) pH salt. – 6.3, and the hydrolytic acidity is 1.77 mg-eq/100g,

(Agroprodservice) pH salt. – 5.9, and the hydrolytic acidity is 1.92 mg–eq/100 g of soil (Table 1).

It is worth to consider the problem separately from the content of alkaline hydrolyzed nitrogen, which is mostly at a low level, because the nitrogen of mineral fertilizers is almost completely lost in the year of its application, this element is the most important element, as the basis of all living organisms.

An important condition in farms with an organic method of land use (Zhyva Zemlia Potutory LLC) is the ban on the use of synthetic mineral fertilizers. Accordingly, to ensure high yields, the producer needs to look for an alternative for them. If it is possible to use natural minerals for phosphorus and potassium, then what to do with nitrogen? This element is directly associated with obtaining maximum productivity. The primary attention of producers to nitrogen fertilizers is also confirmed by statistical data: on 1 ha of arable land, an average of 27.0 kg of nitrogen is applied, which is 4 times more than phosphorus and potash fertilizers! What is the alternative to nitrogen mineral fertilizers? First of all, we are talking about organic fertilizers. In general, in order for the production of products to be considered biological, it is necessary to apply from 14 to 34 t/ha of organic fertilizers. The main purpose of applying such fertilizers is to increase the content of organic matter and improve the nutritional regime. A wide range of macro- and microelements is applied with organic fertilizers.

**We offered the investigated farms alternative ways of enriching the soil with nitrogen.** These are, for example: **1. Compost**, technologies for its accelerated production are emerging. Thus, the technology of accelerated natural degradation of organic substances under controlled conditions has been developed and is constantly being improved. As a result of composting in 60–65 days, a valuable fertilizer is obtained, in which the content of organic substances is at least 75%, and at least 50% of nutrients in a form easily accessible to plants. It also lacks pathogenic microflora in dangerous concentrations, viable weed seeds, and the fertilizer has a weakly alkaline or neutral reaction. As a result of high-temperature biofermentation of the compost mass in aerobic conditions, the nutritional value of the finished product increases, and its environmental friendliness is ensured. Parameters of the finished product: the content of the active substance in 1 ton of compost is at least 50–70 kg, including nitrogen – 15–20 kg, phosphorus – 10–15 kg, potassium – 15–20 kg. Depending on the substrate, the NPK content in compost can be within 1.35; 0.57; 0.97, it has a dark color. Noteworthy is the change in the smell of the compost material – from stinky to the "smell of the earth" caused by the products of actinomycetes' life.

**2. "Green" organic fertilizers – siderates.** Special crops of plants, the above-ground mass of which is partially or completely incorporated into the soil, Siderats contribute to the natural reproduction of soil fertility. In the fields occupied by them, the upper layer does not dry out, the biota does not die, but only promotes photosyn-

thesis, increasing the accumulation of nutrients. As side crops, perennial leguminous grasses are used (asparagus, alfalfa), annual legumes (vetch), which are more useful for enriching the soil with nutrients, as well as buckwheat, oil radish, mustard, as well as mixtures of vetch and seed oats, oil radish and seed oats, phacelia, amaranth, rapeseed, rye grass. **3. Cultivation of leguminous crops.** Due to the nitrogen fixation of nodule bacteria, it is possible to additionally obtain 30–250 kg/ha of nitrogen. After harvesting, more than 30% of biologically fixed nitrogen remains in crop and root residues and is used by subsequent crops. In addition to symbiotic nitrogen fixation, representatives of this family accumulate a significant amount of this element in root and surface residues. Plant residues of leguminous crops with a narrower C:N ratio (20-30:1) mineralize very quickly. Thus, approximately 70% of pea residues are decomposed already in the first two weeks after they are dug into the soil.

This inevitably leads to nitrogen losses. Achieving a balance between the release of nitrogen from decomposing residues and the need for it by crops is the optimal option that ensures an increase in the overall efficiency of the farming system. This can be regulated by the timing of the cultivation of cover crops in the soil. In general, the following dependence is observed: the more mature the plants, the wider the C:N ratio and the slower the process of their decomposition. It is generally known that it is advisable to use the remains of the predecessor (straw, chaff) as a source of nitrogen. In terms of nutrition, 3–4 tons of straw = 9 tons of manure.

This is a "free" source of organic matter and nutrients (+30–40 kg of nitrogen). But in Ukraine, only 45% of straw is directly used in the field, part of which can be burned. Such inefficient use of natural resources is unacceptable, especially in the practice of organic farming. 30–50% of nitrogen is lost from the upper layer by burning the remains of the precursor. It is worth noting that the plant residues of the vast majority of crops are characterized by a wide C:N ratio (60–80:1). That is why, to accelerate mineralization, 10 kg of nitrogen must be applied to 1 ton of straw, 7 kg to 1 ton of corn residues. In this case, it is also possible to do without the use of mineral fertilizers, using the latest approaches to nitrogen nutrition of crops in the organic farming system.

**4. System of minimum tillage. 5. Application of biological preparations (as fertilizers, inoculants, biodestructors, means of protection against diseases and pests).** In conditions of abandonment of mineral nitrogen fertilizers, the need to introduce microbiological preparations, which include nitrogen fixers, is increasing. There are selective strains of nitrogen-fixing microorganisms for certain types of crops: for legumes – rhizobophyte, winter wheat – diazophyte, corn – allobacterin, barley – rhizenterin, sugar beet – polymyxobacterin. And only under the condition of the correct selection of the drug, it is possible to obtain the maximum productivity of nitrogen fixation. To ensure good

development, plants should not experience nitrogen starvation during the entire vegetation period – from the emergence of seedlings to the formation of generative organs. It is worth paying attention to reveal the soil's ability to retain and give nitrogen to plants.

For example, soil with a heavier mechanical composition, where plants are sown with increased density, can give more nitrogen to the plants. Therefore, it is possible to reduce the rate of nitrogen application in this part of the field. But at the same time, more nitrogen may be needed on lighter soils if they have a lower ability to hold and release nitrogen to the plants.

Among those that are most often used is **manure from livestock farms**. However, in terms of nitrogen nutrition, this type of fertilizer is not very effective. The nitrogen content in manure ranges from 0.5 to 0.8%, depending on the species of animals and the chemical composition of the litter. This means that from 25 tons of cattle manure (0.5% N) about 125 kg of nitrogen will be applied, of which the plant will use 40 kg in the first year. This amount is not enough to ensure a deficit-free balance of this element.

The absolute advantage of manure is the optimal C:N ratio of 20:1. Such an indicator is also typical for soils. This means that the manure does not disturb the ratio of carbon to nitrogen. In addition, this fertilizer has a positive effect on the reproduction of soil fertility and significantly increases the indicators of the nutritional regime. The cost of manure is one of the lowest among organic fertilizers. However, there are not many livestock farms left in Ukraine, and to be more precise, the livestock industry is just beginning to recover. This is evidenced by the average rate of application of organic fertilizers – 0.26 t/ha. Therefore, it is not so easy to buy manure, which means that you need to have your own farm.

In order to use manure from livestock farms, the following conditions must be observed: 1. To reduce nitrogen losses, manure must be collected in the shortest possible time. A few days of scattered but unearned fertilizer will cost the farm 30–50% of N; 2. In the conditions of organic farming, the quality of fodder will directly determine the quality of manure. That is, food for animals must be supplied from areas with organic farming to avoid problems with exceeding the MAC for heavy metals, radionuclides or pesticide residues. If the animal consumes a lot of weed seeds with its feed, problems with weeding may arise. And it is forbidden to solve such a problem by chemical means; 3. A variety of microflora "lives" in manure. On the one hand, this is a plus for the soil, on the other hand, there is an additional danger of plant diseases, and therefore, a lack of harvest and a decrease in product quality.

On acidic soils, it is advisable to use excrement – waste from sugar factories. Fertilizer helps restore soil fertility and optimize nitrogen nutrition (0.8% N). However, the stool must meet certain environmental standards. Therefore, it is necessary to carry out its chemical analysis for use.

From the possibilities of applying nitrogen-containing organic fertilizers, we will move on to the cultivation of crops that contribute to the additional accumulation of nitrogen. Therefore, with the help of modern organic fertilizers and microbiological preparations, it is possible to build an optimal system of nitrogen nutrition during organic production. When the soil recovers its functionality after a certain period (10–20 years), the need for nitrogen will decrease to a minimum.

**Conclusion.** More and more agricultural producers are beginning to understand that chemical farming does not meet either their interests or the interests of consumers and are gradually switching to organic farming. Organic agriculture has significant ecological advantages over traditional agriculture: a) Long-term ecological stability. Numerous changes and processes occurring in the natural environment are long-term in nature. Organic agriculture provides a medium- and long-term positive ecologically stabilizing effect on agroecosystems. Aiming at the production of ecologically safe food products, it prevents the depletion of soil fertility and the spread of diseases and pests. Organic agriculture is based on a philosophy that is understandable to society – it is cheaper to warn and prevent troubles than to eliminate them after they have already caused damage;

b) Preservation and reproduction of soil fertility. Such elements of agriculture as crop rotation, use of catch crops, silage, application of organic fertilizers (composts, high-quality humus, by-products of crop production and plant residues) and minimal tillage are the most affordable methods of organic agriculture. They contribute to the development of soil flora and fauna, improve the composition and structure of the soil, contribute to the formation of more stable ecosystems, and play an important role in the fight against water and wind erosion. In the combined interaction, the ability of the soil to retain moisture and nutrients increases, which compensates for the rejection of the use of mineral fertilizers and ensures the preservation and reproduction of soil fertility.

**Use of research results.** The survey data of organic farms show in perspective how to determine the need for soils, establish the most optimal doses of organic and mineral fertilizers, conduct systematic work on increasing soil fertility and the yield of agricultural crops.

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