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5.1 Ecological aspects of the analysis of the activity of the organic form enterprise of the eastern Opillia

Greening is a direction of agricultural development, based on the mastering of ecological methods of management, ensures the 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 methods of management based on the implementation adaptive landscape systems of agriculture, rational involvement in economic turnover and increasing the efficiency of the use of natural, material and labour resources in rural areas [161]. 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 selling their products at higher prices due to their higher quality. The use of leguminous crops in crop rotations allows solving the issue of providing fodder for livestock and organic fertilizers for crop production. Therefore, the majority of ecological farms develop their fields of plant and animal husbandry. The organisation of in-house processing and direct sales of products makes it possible to use the labour force more rationally and increase the company's profit. All the factors listed above, which prove the need of the development of ecological production, fully apply to domestic agriculture as well. Today the uncontrolled use of natural resources, the use of extensive resource-intensive technologies, and 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 agroindustrial enterprises [162]. The environmental responsibility of the development of entrepreneurship in rural areas is mainly associated with the functioning of vertically integrated structures - agricultural holdings. The activities of

these structures have both positive and negative consequences. On the one hand they are able to increase the efficiency of the agrarian sector of the economy, exert a positive influence on the development of business entities in rural areas, regions as a whole, infrastructure, ensure the inflow of investments, implement innovative activities, etc. On the other hand they cause the emergence of acute problems, primarily of an ecological nature. 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 disruption of crop rotation and thus degradation of agricultural lands, reduction of fodder crops, abandonment of animal husbandry.

The cause of a number of environmental problems caused by agriculture is the excessive use of chemicals, primarily mineral fertilisers and chemical plant protection agents. Taking into account the above, the policy of regulation in the field of chemicalisation of agricultural production should be aimed not only at maximising 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" [163,164]. 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 [165].

It should be noted that plowed land in Ukraine is one of the highest in the world and reaches up to 57%, and agricultural land - 80%. Intensive agricultural use of lands leads to their significant depletion, reduction of soil fertility due to their over-compaction, loss of structure, water permeability, etc. As a result, previously fertile lands become unsuitable for further use in agricultural production. Scientists have proven that rational, ecologically safe land use can be ensured when a third of the land will always remain in its natural state. This emphasises the expediency of the developed proposals. Thus, the development of ecologically oriented entrepreneurship cannot happen spontaneously or temporarily, because it is a complex multistage and multilevel process that requires constant monitoring of production processes. 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.

The purpose of writing the article 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; determining the agroecological state of agrarian landscapes located within the zones of influence of man-made objects, as well as conducting an analysis of the state of territories subject to organic farming methods according to a set of indicators characterizing the territorial distribution and intensity of the manifestation of soil degradation processes, the degree of disturbance of the ecological balance in the balance of humus and basic nutrient elements and both ecological and agrochemical state of the lands of intensive agricultural use in the eastern region of Opillia.

Results of observations. 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.

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Along with the production of organic food products in Ukraine, the production of the necessary technological elements is developing: organic seeds, approved by the standards of organic production of plant protection products, biological preparations for combating pests and diseases of plants and animals, fodder and feed additives.

Research on agroecosystems at the "Living Earth of Potutora" 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 whom are Swiss (Elias de Boer and Christina Lieberger). Here, they not only follow the principles of organic production, but 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 farming in the cultivation of herbs involves the use of compost and a lot of manual labour.

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 in Potutory vilage, Berezhany district and LLC "Agroprodservice" Ternopil region. Judging from the data of two farms, the following can be stated: the content of alkaline hydrolysed 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 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.

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. It should be noted that there is a significant spatial heterogeneity of nitrogen provision even within one field, which requires a differentiated approach when developing a feeding system. When calculating doses of nitrogen fertilizers, the residual nitrate of the soil is taken into account. The main forms of nitrogen released in fertilizers are: Amide (NH_2). It is transformed in the soil into ammonium, and later nitrate form. Ammonium (NH_4). The ammonium form of nitrogen is partially transformed into the nitrate form. Nitrate (NO_3) is not retained by the soil and is easily washed into deeper layers.

Lack of nitrogen strongly inhibits the growth and development of the plant. Appears in the form of chlorosis. The leaves become light green, small leaves turn yellow prematurely from the tips. In cereals, tillering slows down, stems are short. On crops, there is a deterioration of flowering, early fall of the ovary. Also, taking into account the high ability of nitrogen to be reutilized and the well-developed grass vegetation, it can be assumed that at the beginning of the growing season, the reserves of alkaline hydrolyzed nitrogen in the studied soils may increase by 15-20% compared to the recorded values. Yield can be significantly reduced if nitrogen deficiency accompanies the entire growing season.

An important condition in farms with an organic method of land use (Living Earth-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.

"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 photosynthesis, 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 the conditions of refusal 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 - albobacterin, 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 (Fig. 2).

Діапазони кількостей азоту симбіотично фіксованого із рослинних решток
після збору врожаю (Briggs et al 2005)

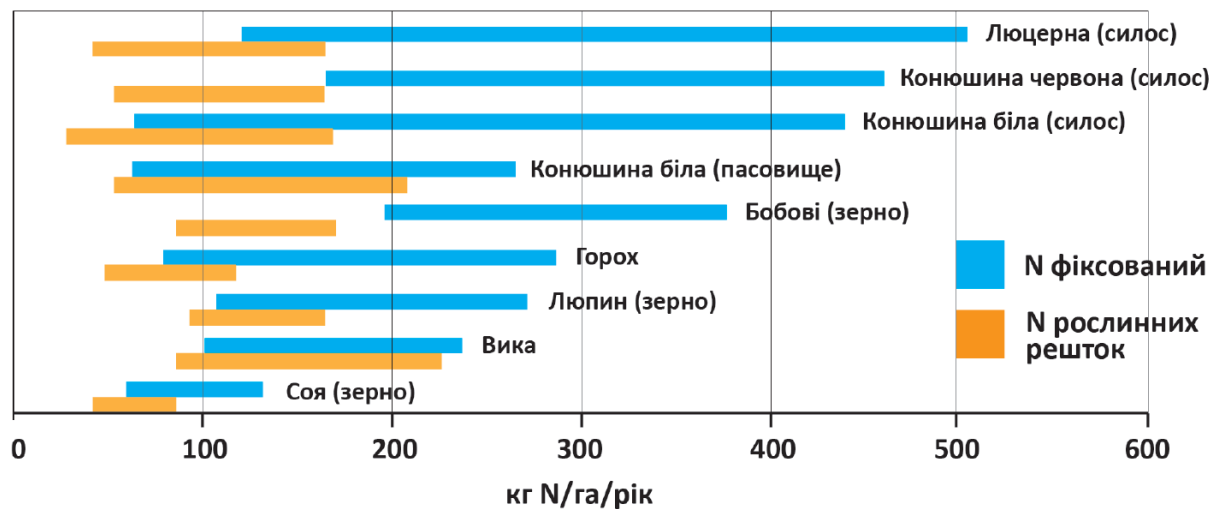


Figure 2. Fixed nitrogen of plant residues of leguminous crops.

Let's consider how to use nitrogen most effectively and how to avoid mistakes when applying nitrogen fertilizers. Often, even successful and experienced farmers hesitate when certain field situations arise: whether to apply nitrogen fertilizers or not. There is a simple rule: if the plants can take these fertilizers, then they can be applied. But if it is dry, or the plants are in a state of stress, or at the last stage of ripening and the plant tissues are already dead, then fertilizers should not be applied. After all, in this case, plants are unable to consume and assimilate nutrients from fertilizers, and therefore, to turn them into a crop.

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 (Fig. 3).

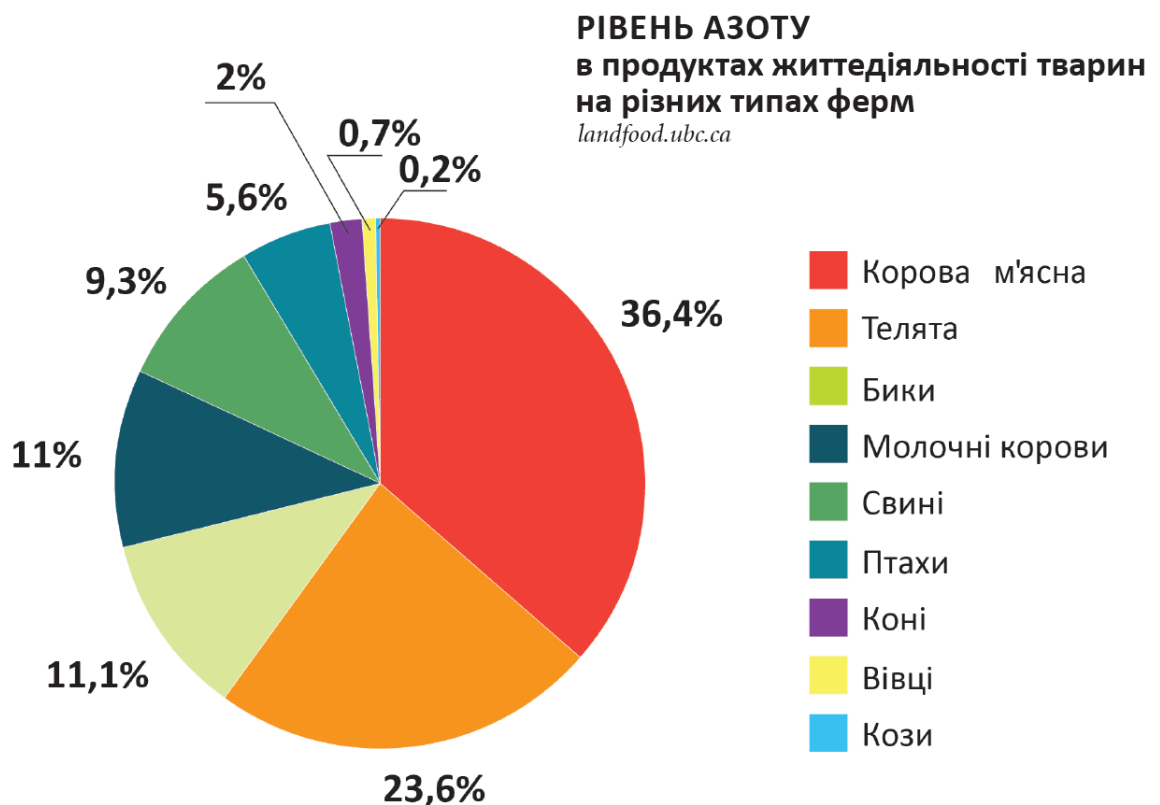


Figure 3. Manure from livestock farms.

Here are some tips for using this fertilizer:

1. To reduce nitrogen losses, manure must be applied 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 excreta - 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 possibility 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. We have a closed circle, from which it is possible to break out only through the creation of reliable ecological protection systems against harmful emissions into the air, wastewater treatment and the cultivation of organic agricultural products. Ukraine should use the world experience of conducting environmental activities taking into account the ecological requirements of environmental protection. Thus, world practice highlights the following principles of ecologically oriented agricultural production:

- 1) establishment of agricultural management rules - the Code of Good Agricultural Practice;
- 2) spread of low-cost (balanced, compromise, adaptive) production systems;

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3) the development of organic (biological, ecological) production - involves the widespread use of biological approaches in agricultural production, the refusal to use pesticides or their regulated use only in seed processing, the ban on the use of genetically modified organisms, etc.

We would like to conclude with the words stated in the preface to the basic rules of the International Federation of Ecological Agriculture IFOAM, which was created in 1972 in Versailles: "Since time immemorial, man has known that his ability to influence the environment far exceeds his right to do so."