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Priorities of Ecologically Oriented Economic Development of the Agricultural Sector

Abstract. *The article considers the main factors of anthropogenic impact that affect the environment; a number of major environmental challenges in the agricultural sector that affect the stable economic growth of agricultural production are identified. It is established that the transformation processes in the life of society are contradictory in relation to the interaction of nature and society, significantly exacerbate the degrading changes in the environment. Violations of the technology of cultivation, storage and application of mineral fertilizers, their properties and chemical composition, imperfection of their use have led to increased negative impact on certain components of the biosphere, soil environment, the environment and man. Practice shows that intensive technologies for growing field crops increase the possibility of soil contamination with fertilizer residues, pesticides, herbicides and other toxicants. The presence of toxic substances in the soil is accompanied by their accumulation in surface and groundwater. This is one of the main environmental factors that affect the quality of products and soil quality. Ensuring environmental safety should be decided in the light of world experience, taking into account the specifics of the country's geographical location, ensuring that the economic interests of agricultural producers are aligned with the environmental requirements of environmental protection. In view of this, the problem of increasing the efficiency of agricultural production through its greening, starting with the organization of the rational use of natural resources as the main means of production, becomes especially relevant. An important element of economic activity of agricultural enterprises is to take into account environmental factors in order to increase the economic efficiency of agricultural production and preserve ecosystems.*

Keywords*: environmental challenges; environmental threats; economic growth; innovative solutions; greening.*

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Анотація. *У статті розглянуто основні чинники антропогенного впливу на навколишнє природне середовище; визначено коло основних екологічних викликів в аграрному секторі, які впливають на стабільне економічне зростання сільськогосподарського виробництва. Встановлено, що трансформаційні процеси у житті суспільства мають суперечливий характер щодо взаємодії природи і суспільства, істотно посилюють деградаційні зміни навколишнього природного середовища. Порушення технології вирощування, зберігання та застосування мінеральних добрив, їхні властивості і хімічний склад, недосконаліть способів їхнього використання спричинили посилення негативного впливу на окремі компоненти біосфери, ґрунтове середовище, на стан навколишнього природного середовища та на людину. Практика засвідчує, що інтенсивні технології вирощування польових культур збільшують можливості забруднення ґрунтів залишками добрив, отрутохімікатами, гербіцидами та іншими токсикантами. Наявність токсичних речовин у ґрунті супроводжується їхнім накопиченням у поверхневих і підґрунтових водах. Це є одним із основних екологічних чинників, яких впливає на якість отриманої продукції та якість ґрунту. Гарантування екологічної безпеки повинно вирішуватись з огляду на світовий досвід, із врахуванням специфіки географічного розташування країни забезпечення приведенням у відповідність економічних інтересів сільськогосподарських товаровиробників до екологічних вимог*

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збереження довкілля. Особливої актуальності набуває проблема підвищення ефективності сільськогосподарського виробництва завдяки його екологізації, починаючи з організації раціонального використання природних ресурсів як основних засобів виробництва. Важливим елементом господарської діяльності аграрних підприємств є врахування екологічних чинників з метою підвищення економічної ефективності сільськогосподарського виробництва та збереження екосистем.

***Ключові слова**: екологічні виклики; екологічні загрози; економічне зростання; інноваційні рішення; екологізація.*

Formulation of the problem. The Association Agreement between Ukraine and the European Union pays considerable attention to environmental protection and strengthening of environmental protection. According to Annex XXX of the agreement, Ukraine undertakes to approximate its legislation to the EU legislation, which will directly affect companies whose work in one way or another affects the environment. With the development of technology and increasing speeds, man has become much more influential on the environment. Therefore, the legislation of Ukraine and the world community is changing.

The introduction of European integration provisions of agricultural policy and practice in Ukraine allows to lay a solid economic foundation for ecological and sustainable development of agricultural production on the European basis, reduce land degradation, improve the living environment of the rural population, promote domestic agricultural products. Ignoring the environmental problems of Ukraine's agriculture in the future will only worsen the situation, unbalance the interconnected structural restructuring of all its branches, slow down the introduction of the most important achievements of scientific and technological progress, world experience, the most progressive forms of economy and organization of production [1].

Many agricultural companies are already required to assess the impact on the environment, even at the project level for investment. Operating companies are also forced to take into account economic, environmental and social factors, especially if their products or services are supplied to the European Union. Regulation in Ukraine is becoming tougher, more demanding on business, and this should be taken into account in further development. Ultimately, these are regulatory risks, a direct risk of environmental impact that can subsequently generate economic and social risks, as it affects the human environment.

Analysis of current research and publications. Transformational processes in the life of society are contradictory in terms of the interaction of nature and society, the strengthening of anthropogenic impact on nature. On the one hand, positive phenomena are intertwined: improvement of technologies and growth of production, promotion of fuller satisfaction of human needs, rational use of natural resources, increase of food production, economic stability; on the other hand - negative phenomena: increased soil erosion, environmental pollution, acid rain, as a consequence, deterioration of human health, additional costs to eliminate the negative consequences, and so on.

Such an intertwining of positive and negative phenomena is present in the agricultural sector. Its development today is impossible without the use of mineral fertilizers, which will increase yields, increase soil fertility, the quality of agricultural products. But violations of the technology of production, storage and application of mineral fertilizers, imperfection of their properties and chemical composition, imperfection of their use can lead to a negative impact of mineral fertilizers on certain components of the biosphere, the environment and man. Environmental pollution with the use of mineral fertilizers is mainly due to non-compliance with scientifically sound standards, insufficient funding for innovative projects.

The urgency of the issue is due to the growing need to preserve the natural environment, conservation and protection of soils. Areas, according to the topic of the article, were studied by such domestic scientists as O. Balatsky, V. Borisova, V. Gorlachuk, S. Doroguntsov, B. Danylyshyn, S. Rohach, P. Sabluk, V. Savchuk, E. Khlobystov, N. Bobrovska [3, 9, 12, 13], O. Vyshnevska [6, 9, 13], K. Gorbunova [15], O. Kotikova [2, 4], O. Melnyk [1, 7], N. Potryvaeva [8] and others.

Formulation of research goals. Substantiation of theoretical bases for assessing the impact of anthropogenic factors on the efficiency of agricultural production and the environment, identifying opportunities for agricultural production, reducing land degradation, improving the living environment of the rural population, implementing priority approaches to environmental and economic security, environmentally oriented agricultural sector.

Presenting main material. Intensive technologies for growing field crops increase the possibility of soil contamination with fertilizer residues, pesticides, herbicides and other toxicants. The presence of toxic substances in the soil is accompanied by their accumulation in surface and groundwater. This is one of the main environmental factors that affect the quality of products and soil quality in general and occurs as a result of the annual use of plant protection products and increase soil fertility in large areas. Therefore, clear control over the proper use of fertilizers, pesticides, chemical ameliorants is needed [2].

The use of mineral fertilizers should be regulated by agro-technical and hygienic standards: the rate of fertilizers per unit area and the ratio of nutrients for individual crops, timing and methods of application, the maximum allowable level of nitrates and nitrites in products. Fertilizer application not only contaminates soils, but also accumulates fertilizer components in

groundwater aquifers, which reduces usable fresh water reserves.

In today's conditions, there are many agricultural measures that do not cause an excess of nitrates in the soil. Among the external factors of nitrate accumulation in crop products, the main role is played by the level of nitrogen nutrition of plants.

Conducting progressive agricultural production without nitrogen fertilizers is impossible. Farmers use them to grow both vegetables and cereals, industrial crops. Nitrogen-containing chemicals have varying degrees of stability and digestibility. Yes, some of them are poorly soluble in water, others are quickly washed out of the soil. The optimal time of application and dosage of application depends on these signs. Make nitrogen fertilizers in the form of granules, powder or liquid solution. The latter can be introduced into the soil - to feed the root system, or on the leaves - foliar feeding. The optimal time, type and method of application of ammonia fertilizer is determined according to the technology of growing crops.

Excessively high doses of nitrogen fertilizers can increase the content of nitrates in plants by 1.5 - 8 times compared to the optimal and scientifically sound doses of fertilizers, which should be adjusted in accordance with the total reserves of mineral forms of nitrogen in the soil. According to the ecological and toxicological regulation of the use of fertilizers, according to which, depending on the nitrogen content in the soil, it is planned to apply no more than 140 kg / ha of nitrogen for winter wheat (160 kg under irrigation), 100 for winter rye and spring barley, 120- corn (180 under irrigation), 65 - buckwheat, 75 - millet, 160 - sugar beet, 120 - potatoes, 90 - tomatoes (120 under irrigation), 60 - cucumbers and table beets, 60 kg / ha of nitrogen - for carrots [3].

It is necessary to adhere to the principle of balanced nutrition between macro- and microelements. Given the increased risk of accumulation of nitrates in the product, it is desirable to increase the doses of phosphorus and potassium and make trace elements - molybdenum, copper and manganese, which activate the enzymes involved in the reduction of nitrates to ammonia.

Given that nitrogen fertilizers are rapidly soluble, it is desirable to apply as widely as possible their application in parts (they are applied several times during the growing season), according to the needs of field crops, the main stages of organogenesis, using soil-plant diagnostics. Fertilizer application methods should also be considered. In particular, their local application to the soil helps to reduce the loss of nitrogen gaseous compounds by 1.5 - 2 times, which is enhanced by inhibition of nitrification due to the high concentration of salts in the fertilizer strip on the activity of nitrifying microorganisms.

However, precipitation leads to the fact that most of the fertilizers are not absorbed by the root system of plants and washed into the deep layers of the soil, which leads to its contamination (losses of fertilizers from the arable soil layer can be up to 40%). Therefore, there is a real risk of large amounts of nitrates entering groundwater aquifers.

Therefore, the most perfect nitrogen fertilizer today is urea-ammonia mixture (CAS), which is an aqueous solution of ammonium nitrate and urea in the ratio of 35.4% urea, 44.3% nitrate, 19.4% water, 0.5% ammonia water. The composition and ratio of components indicate that CAS contains three forms of nitrogen - ammonia (25%), amide (50%) and nitrate (25%), so the fertilizer is prolonged, and plants are supplied with nitrogen throughout the growing season. All forms in the fertilizer are not volatile and do not cause nitrogen loss, so it can be applied superficially without wrapping in the soil.

Nitrate and ammonia forms are directly available to plants. Initially, nitrate nitrogen is absorbed, which is very mobile in the soil. Ammonia is retained in the soil and does not leach into deeper layers. When CAS is introduced into the soil, this form accumulates in the arable layer and becomes available to plants during the growing season. Part of the ammonia form is converted into nitrate. Amide in the soil is transformed into ammonia, and later into nitrate. This nitrogen absorption system makes CAS a fertilizer with both fast and long-lasting action.

One of the possible ways to reduce the negative impact on the soil is the use of encapsulated fertilizers with controlled release of mineral fertilizer components, which allows to predict the rate and duration of fertilizer release from the capsule depending on environmental conditions, reduce fertilizer losses from the arable layer [4].

According to the results of experimental studies, the leaching of encapsulated fertilizers is much slower, which creates favorable conditions for the assimilation of dissolved fertilizers by the root system of plants. Only after complete release from the capsule, the fertilizer will be washed out of the soil layer. The use of encapsulated fertilizers, especially nitrogen fertilizers, which are rapidly soluble, reduces fertilizer losses due to leaching by atmospheric fertilizers. The release of fertilizer components from the capsules is slow, depending on the permeability of the polymer coating, which, in turn, allows to ensure uniform fertilization of crops depending on soil and climatic conditions and reduce the negative impact on soils as a whole.

Applying nitrogen fertilizers does not completely solve the problem of nutrition. Many plants also need phosphorus and potassium to absorb nitrogen, so fertilizers need to be able to calculate and balance so that the plant receives all the necessary elements.

Potassium plays a crucial role in crop physiology, participating in water distribution and enzymatic processes. Adequate available potassium can alleviate the stress that plants tolerate during heat, cold or drought. Potassium is an element that affects the yield of many crops, especially such as potatoes, vegetables and fruit trees. Potassium is needed for these crops especially at the stage of tuber formation or fruit ovary, and it also

affects the color of the fruit, their taste and quality of storage.

For many vegetable crops, the need for potassium is much higher than for nitrogen, at the rate of kg / ha. Thus, 1 ton of potato tubers usually requires 6 - 7 kg of K2O. Clay soils contain a large amount of potassium in contrast to the lungs, so the latter need more of this element. On the other hand, potassium is prone to leaching, so for vegetables and other crops with a long growing season and a high need for potassium, it is recommended to gradually feed this element. Peculiarities of application and environmental impact of nitrogen fertilizers are summarized in the table. 1.

Table 1. **Features of application and impact on the environment of nitrogen fertilizers**

Type of fertilizer	Application	Impact on the environment
Ammonium nitrate	Universal high-performance ammonium nitrate fertilizer works equally effectively on almost all types of soils, for all crops, as pre-sowing, sowing or fertilizing. The most rational and effective ammonium nitrate is when applied for spring fertilization of winter cereals.	In conditions of sufficient moisture leaching of the nitrate form of nitrogen is possible. Prolonged use increases soil acidity.
Limestone-ammonium nitrate	Highly concentrated fertilizer that contains calcium and magnesium. The main value - has no special requirements for soils, geographical areas of cultivation or type of agricultural crops. Contains magnesium and calcium carbonates, especially effective on acidic and slightly acidic soils.	The negative impact is manifested on soils with low calcium content (acidic sod-podzolic). Systematic application may cause acidification of the soil solution. Significant disadvantages include high hygroscopicity (during long-term storage quickly coagulates).
Urea (Urea)	Concentrated solid fertilizer used in the cultivation of cereals, industrial, vegetable and even fodder crops. When used as foliar fertilization, even in high concentrations, it is well absorbed and does not cause burns.	In the process of granulation, urea is formed in urea. At a content of 3% biuret is toxic to plants. A single application of urea should not exceed 2.5 kg / ha. Permissible concentration of urea solution for foliar feeding of cereals is 5-30%.
Urea-ammonia mixture (CAS)	Highly concentrated liquid fertilizer, which is effectively used in areas of insufficient moisture. The norm of nitrogen is entered more evenly and precisely; slightly higher nitrogen utilization rate by plants.	Does not contain free ammonia. The fertilizer is prolonged. The technology of CAS application involves the distribution of nitrogen more evenly and accurately on the soil surface compared to solid nitrogen fertilizers.

Source: created and supplemented by the author on the basis of materials [5, 7, 12, 13]

Potash fertilizers pollute the environment to a lesser extent. Negative effects are mainly associated with potassium anions: chloride, sulfate and others. Harmful impurities contained in potash fertilizers can also include chlorine, which enters the soil in large doses and adversely affects the yield of potatoes, grapes and other crops.

If you apply 45-50 kg / ha of potassium fertilizers (based on K_2O), then 30 - 35 kg / ha of chlorine anion come with them, which leads to artificial salinization of soils. In addition, the accumulation of significant amounts of potassium in the soil can lead to a violation of the relationship between potassium and sodium in drinking water and food, which can adversely affect human health - cause disruption of the cardiovascular system.

Sodium (concomitant potassium in potassium salt and sylvinite), applied in large doses, contaminates the soil, impairs the physicochemical properties of many soils, especially chernozem, chestnut and saline, as it increases their salinity. Excess potassium in feed can cause animal poisoning. In addition, the accumulation of significant amounts of potassium in the soil can lead to a violation of the relationship between potassium and sodium in drinking water and food, which has a negative impact on human health.

Systematic application of increased doses of fertilizers such as potassium, reduce soil fertility and have a negative impact on the environment due to the fact that the content of these fertilizers so-called ballast elements (Cl, Na) can accumulate in the soil. The application of large doses of potassium fertilizers can cause increased concentrations of chloride ions, disrupt the relationship between the cations Ca_2 +: K +, Mg_2 +: K +, displace calcium and magnesium from the soil complex, as well as increase their migration along the soil profile.

Potassium leaching is influenced by the physical and mechanical properties of the soil, in particular the particle size distribution and water permeability. It is washed out less from heavy soils than from light ones. Surface wastewater leaches potassium from the soil, and groundwater - potassium fertilizers. Metals contained in potassium fertilizers (Cd, Hg, Pb, AI) can accumulate in living organisms, penetrate into groundwater and more. Along with potassium fertilizers, chlorine anions also enter the soil. Features of influence and specific conditions of use of potash fertilizers on some cultures are generalized in the table 2.

Table 2. **Features of influence and specific conditions of potash fertilizers use on some cultures**

Cultures	Impact on culture	Negative impact
Rapeseed	Increases the resistance of rape to lodging, disease, winter hardiness; increases the number of seeds in the plant and the weight of 1000 seeds.	Negative effects are mainly associated with potassium anions: chloride, sulfate and others. Harmful impurities contained in potash fertilizers include chlorine, which in large doses adversely affects the yield of crops such as potatoes, grapes, peas, carrots, onions and cucumbers. Chlorine has a bad effect on the growth of these crops and quality indicators. Due to the high salt index, potassium fertilizers should not be applied together with the seeds in one hole, as this may adversely affect the quality of seed germination. Potash fertilizers should not be applied on chestnut soils without additional splicing, salt marshes, as this will not have an agronomic effect, but will only cause their salinization. With excessive potassium nutrition of plants, a mosaic of pale spots first appears between the veins of the leaves, which eventually turn brown and the leaves fall off. The growth and flowering of plants are inhibited, the content of starch in potato tubers decreases, their taste deteriorates. Excess potassium in the soil is observed magnesium starvation of plants.
Sunflower	Participates in carbohydrate metabolism, water transport and direct hydration of cells; increases drought resistance of sunflower, helps to retain moisture and reduces its evaporation.	
Soy	Increases crop yield and oil content.	
Sugar beet	Increases the hydrophilicity of plasma and water holding capacity, which helps to maintain the optimal state of the structure of organelles and protoplasts in general; provides resistance of plants to diseases.	
Fruit trees	Improves the taste and marketability of fruits, increases the resistance of fruit and plants to fungal and bacterial. diseases, improves sugar content.	
Wheat	Accelerates the work of enzymes that accumulate sugars and synthesize protein; increases cold and frost resistance; resistance of plants to fungal diseases; a well-developed root system is formed; the negative effect of excess nitrogen nutrition is weakened; normalizes photosynthesis.	
Corn	Promotes efficient use of moisture, increases resistance to drought, improves nitrogen uptake by the plant; increases resistance to lodging and stem rot.	

Source: created and supplemented by the author on the basis of materials [4,5,7,13]

Phosphorus is part of a triad of elements vital to plants. Unlike the other two - nitrogen and potassium, which are responsible for the growth and taste of products, phosphorus controls the constant metabolic processes, being a source of energy. It is part of DNA and RNA, as well as many other substances that play a significant role in the life of plant flora.

Phosphorus has a significant effect on the physiology of the culture, as it plays a crucial role in the energy distribution of the plant. The need for phosphorus is especially high at the beginning of the season for root formation, as well as later during flowering and fruit set. Deficiency symptoms begin to appear on old leaves when their edges and tips become dark or purple.

Phosphorus is well retained by soil particles and therefore is not a moving element, on the contrary, it is one of the most stationary. Its solubility, availability, mainly depends on the soil temperature and pH, the optimal value of which is in the range of 6 - 7.

Much of the phosphorus consumed by plants comes from soil reserves, including fertilizers used in previous years. Only a small part comes from phosphorus used during the season. As a result of such a complex scheme, it is recommended to use approximately the same amount of phosphorus for each culture. Thanks to such agricultural techniques, it is possible to keep soil fertility for a long time.

But mineral fertilizers containing phosphorus can lead to the accumulation in the soil of chemical elements that have natural radioactivity. It is known that in some US states the concentration of uranium-238 in soils has doubled in 80 years of phosphorus fertilizer application. A similar phenomenon was also observed in Germany, where the content of naturally occurring radioactive elements (uranium and radium) on cultivated soils is 6-9 percent higher than on uncultured soils. A significant amount of stable strontium enters the soil with simple superphosphate.

The effectiveness of fertilizer use depends on the reliability of determining the balance of nutrients in the soil. After all, the systematic increase in soil fertility directly affects the level of yield and quality of agricultural products, because the use of complex mineral fertilizers changes the balance of soil nutrients [5].

The domestic market presents complex fertilizers of two types: liquid and granular. According to the method of production, complex mineral fertilizers are divided into:

– mixed (a mixture of simple fertilizers obtained by dry mixing);

– difficult - mixed fertilizers or combined (complex fertilizers, which are obtained in a single technical process in one granule contain two or more basic plant nutrients);

– complex (obtained by chemical interaction of the source components).

Mineral fertilizers are made for all crops, taking into account the chemical composition of the soil and particle size distribution, one granule contains several elements of mineral nutrition. Complex mineral fertilizers can be single salts with different nutrients, and their compositions of two or three nutrients. Such compositions are prepared

by reacting nitric, phosphoric and sulfuric acids with ammonia, natural phosphates, potassium salts, ammonium and others like these. The higher the total content of the active substance in the fertilizer, the more valuable it is. In addition, the composition of fertilizers may include sulfur, magnesium, trace elements.

There is a tendency to increase the share of complex fertilizers in the range. The production of complex fertilizers is more cost-effective, because in practice not one nutrient is applied at the same time, but two or more, while the separate application of each fertilizer requires additional costs and corresponding labor costs [6].

On the other hand, complex fertilizers together with phosphorus play a significant role in soil pollution. Phosphates absorbed by the soil are sedentary and almost do not leach (only 2%) from the arable layer. With excessive use of phosphorus and complex mineral fertilizers in the soil accumulates P2O5 in such quantities that can inhibit self-cleaning processes. Phosphorus and complex fertilizers contain impurities of selenium, arsenic, heavy metals, natural radionuclides - uranium, radium. Therefore, if the application rates of these fertilizers are exceeded, the soil may become contaminated with harmful substances.

It was found that the excessive content of superphosphate in the soil increases the cadmium content in potatoes by 4 times. With phosphorus and complex fertilizers, 3-4 g / ha of cadmium is applied to the soil annually, this value can reach up to 10 g / ha. Depending on the type of soil, the amount of precipitation and the technology of application of phosphorus fertilizers (doses, terms, forms, methods of application, etc.), the concentration of phosphorus in river waters (spring) can be 0.12-0.16 mg/l. The maximum permissible concentration of phosphorus in drinking water is 10 mg / l. Therefore, in order to prevent the possibility of inclusion in the biological cycle of toxic and radioactive elements, the use of phosphate fertilizers should be under the constant control of environmentalists, producers, landowners.

The application of mineral fertilizers is a mandatory point in the algorithm of modern agronomist. But due to the negligence or imperfection of the composition, this seemingly beneficial process can harm both crops and the environment as a whole. If low-quality raw materials are used for the production of fertilizers, which contain a significant amount of harmful impurities, this leads to the presence of heavy metal salts and radioactive isotopes in their composition [7].

The reasons for the growth of anthropogenic impact on the environment are identified:

1. Imperfection of organizational forms: technology of production, transportation, storage, mixing and application of mineral fertilizers. When transporting fertilizers, storing and applying them to the soil, the losses are 10-15%. Unfertilized fertilizers during their storage change their particle size distribution, which causes segregation of mixed fertilizers. When such fertilizers are applied to the soil, their distribution is uneven [8].

2. Imperfect quality of mineral fertilizers, their chemical, physical and mechanical properties. The content of various impurities and ballast substances (salts of heavy metals, radioactive substances, organic compounds) which, along with the main nutrients contained in mineral fertilizers, can be up to 5%. Most impurities are toxic substances. Ballast substances (chlorine, sodium, etc.) that enter the soil with fertilizers adversely affect its properties, get into groundwater, pollute water bodies.

3. Violation of the technology of mineral fertilizers and non-compliance with the optimal ratio of nutrients. Disturbance of the balance of nutrients in the soil causes an increase in soil acidity and changes the mobility of trace elements, including heavy metals. Violation of optimization of plant nutrition by macro- and microelements leads to various plant diseases, deterioration of plant products and accumulation of nitrates in it.

4. Atmospheric air pollution by gaseous fertilizer products. As a result of denitrification processes in the soil, part of the nitrogen is weathered and returned to the atmosphere, thereby contaminating the atmosphere with chemically active nitrogen compounds, which leads to the formation of acid precipitation. Significant losses of nitrogen gas are characteristic of soils not occupied by vegetation. Nitrogen losses in the steam field increase sharply compared to occupied steam. The largest amount of volatile substances is released from liquid nitrogen fertilizers (ammonia water and liquid ammonia).

5. Change in soil microbiological activity. The soil microflora is affected by mineral fertilizers (primarily nitrogen), they mostly activate the activity of microorganisms (bacteria, algae, fungi, actinomycetes) and microfauna (protozoa, nematodes). However, at high concentrations of ammonia in the area of liquid nitrogen fertilizer, the vital activity of soil microflora is temporarily inhibited, which leads to inhibition of nitrification, ammonification, etc.

6. Inflow of mineral fertilizer elements from the soil into groundwater or with surface runoff into natural reservoirs, which leads to eutrophication of reservoirs and pollution of drinking water. The more precipitation, the greater the loss of nutrients in the soil due to their leaching.

Contamination of soils with heavy metals is of great interest to modern science due to the increasing man-made impact on the environment. They are one of the most toxic pollutants of anthropogenic origin. The danger of entering the environment of heavy metals is determined by the fact that they are not destroyed, but pass from one form to another, in particular included in the composition of salts, oxides, organometallic compounds.

Lands and soils play a multifaceted role in the development and functioning of the biosphere, provide

the biological cycle of substances in nature, are the main environment for production in agriculture, the spatial basis for the location and development of all sectors of the national economy [9]. The accumulation of heavy metals in the soil leads to an increase in their concentration in plants and to a decrease in crop yields, to partial or complete loss of soil fertility. This group includes elements such as fluorine, vanadium, chromium, manganese, cobalt, nickel, arsenic, mercury, lead and some others. The main sources of heavy metals entering the soil are technological, they are means of chemicalization of agriculture, fuel combustion products, industrial emissions, when using chemical ameliorants, phosphorus fertilizers, fluorine, strontium and others get into the soil.

Man-made dust, which is released due to the operation of heavy industry, on average contains: zinc - 6.72%, lead – 0.11%, cadmium – 0.01%. The soil anomaly of pollution is observed within a radius of 7 km. Emissions from such enterprises spread within a radius of 10-40 km, settling on plants and penetrating into the soil to a depth of 10-15 cm. Therefore, crops grown in industrial areas accumulate toxic components of such emissions, which can lead to reduced yields and death plants.

Together with industrial centers, large productions, operating transport arteries, the source of pollution of agricultural lands with heavy metals is industrial or household waste, buried in certain places, or unauthorized landfills. In local areas, the soil is contaminated with hazardous heavy metals such as mercury, cadmium, lead, chromium, copper, zinc and arsenic (non-ferrous and ferrous metallurgical wastes, energy, chemical industry). Therefore, in Europe, the problem of unauthorized landfills of household and industrial waste is given enough attention. The cost of dealing with the effects of environmental pollution in Europe is more than 10 billion euros [10]. Heavy metals are toxic and interfere with the activity of soil microflora. Their concentration in the soil can persist for decades and even centuries. Reducing heavy metal emissions is the most affordable way to limit their impact on soils.

One of the most harmful toxicants is cadmium. Once in the soil, it is absorbed by the root system of plants, accumulates in them and through food chains can enter the body of animals and humans. Lead also has the highest accumulative capacity in the bodies of warm-blooded animals and humans. As a result of soil contamination with these metals, the end links of the food chain, including humans, are most at risk.

Cadmium, mercury and lead are almost impossible to remove from the soil, so they increasingly accumulate in it and get into the human body in different ways. The main direction of reducing the content of heavy metals in plant products is the development of innovative technological methods to reduce their mobility in the soil.

The usual component of the biosphere is natural radiation, it is an environmental factor that affects all living organisms and creates a natural radiation background. It is formed due to cosmic radiation, radiation from external terrestrial and internal sources. The content of natural radionuclides in the earth's crust varies in a fairly wide range. Accordingly, in different parts of the Earth, the natural radiation background is also variable.

It should be noted that since the last century, the natural radiation background of the Earth is gradually increasing. This is a consequence of the industrialization of the human economy, which has also led to the extraction from the bowels of the Earth and entry into the environment, along with minerals such as coal, oil, gas, building materials, metal ores, salts, etc., large amounts of radionuclides.

Emissions from nuclear power plants make a certain contribution to environmental radiation. Nuclear energy, given the danger of nuclear radiation, is built on the principle of a closed cycle, due to which only a small amount of radioactive substances difficult to capture enters the environment.

The analysis of the main threats to the soil environment of Ukraine cannot be carried out without taking into account the consequences of the Chernobyl accident, as it caused a significant negative impact on the overall environmental situation in the country. After the Chernobyl accident, the area of contaminated areas in Ukraine has increased significantly. More than 4.6 million hectares of land in 12 oblasts have been contaminated with radionuclides, including 3.1 million hectares of arable land, about 400,000 hectares of natural fodder lands, and more than 3 million hectares of forests. 119 thousand hectares of agricultural land were withdrawn from land use, including 65 thousand hectares of arable land [11].

Radiation sources affect the environment, living organisms, soils. Living sources in the environment can be constantly affected by several radiation sources at the same time. Ukraine has accumulated significant amounts of radioactive waste (RW). They were formed both as a result of the Chernobyl accident and during uranium ore mining, operation of nuclear power plants, use of sources of ionizing radiation in industry, medicine and scientific institutions. RW volumes are constantly growing due to the operation of nuclear fuel cycle facilities and the decommissioning of NPP power units. During all stages of the nuclear fuel cycle, radionuclides can enter the soil environment, but the intensity of the impact of the radiation factor on the environment in different parts of it is different.

Ukraine needs a maximum of 15 million hryvnias to decontaminate radiation-contaminated soils. However, neither decontamination of radioactively contaminated lands nor other general preventive measures have been carried out in Ukraine for several years. The lion's share of this money should go to the purchase in Germany - the only drug that completely removes from the soil and the human body radioactive cesium, which has now accumulated in contaminated areas. Funds are also needed for liming soils with a high cesium content and

applying mineral fertilizers. Such measures reduce the radiation in the soil by half [12].

Soil not only accumulates components of pollution, but also acts as a natural buffer, which significantly reduces the toxic effects of heavy metals and regulates the flow of chemical elements into plants and, consequently, into animals and humans. Unlike the atmosphere and hydrosphere, where the processes of periodic self-cleaning of heavy metals are observed, the soil has almost no such ability to self-clean. Metals that accumulate in soils are removed from it very slowly only during leaching, plant consumption, erosion and deflation [13]. That is why the development of agronomic measures to reduce the influx of heavy metals into agricultural plants is of significant agri-environmental importance.

Man has reached the heights of modern civilization due to the fact that he is constantly changing nature in accordance with their goals. People achieved the goals they had hoped for, but received consequences they did not expect. Man was able to influence the course of natural processes, conquered the forces of nature, began to master almost all available renewable and non-renewable natural resources, but at the same time pollute and destroy the environment.

Transformational technological processes change the relationship of man with nature, creates new conditions for its existence, significantly affects the way of life and work. Human intervention in natural processes increases sharply and can cause changes in groundwater and groundwater in entire regions, surface runoff, soil structure, intensification of erosion processes, activation of geochemical and chemical processes in the atmosphere, hydrosphere and lithosphere, microclimate changes, etc. [14].

Conclusions. It follows from the above that most modern environmental challenges are due to anthropogenic pressure on nature. This intervention is primarily due to human economic activity, the growing human need for resources. All this has a very negative impact on the environment: depletion of natural resources, pollution of land, air, water; accidents, etc. Rational use of nature, strict control over emissions and exploitation of natural resources, rational use of mineral fertilizers - are a prerequisite for reducing the negative impact on the environment.

Studies show that the reduction of anthropogenic impact on the environment, protection and conservation of soils should be a complex combination of technological change and innovative management solutions. The experience of EU countries shows that an element of economic activity of agricultural enterprises to reduce environmental threats to the agricultural sector and security of territories is to take into account environmental factors to increase economic efficiency of agricultural production and preserve ecosystems and require the introduction of systemic environmental measures.

Planning of economic activity of agricultural enterprises and improvement of directions of the agricultural sector sustainable development should be based on priority strategic tasks taking into account natural resource potential and ecological condition of agriculture.

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