

Greening and agroecological assessment of the agricultural sector of the Karabakh region

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ABSTRACT

State of the problem. During the occupation by Armenia of the Karabakh economic district of the Republic of Azerbaijan, the military degradation of agricultural lands and their use in agriculture and animal husbandry without observing agroecological rules led to the deterioration of soil fertility and the reduction of the optimality of agrarian landscapes.

Object learning. The article presents modern ideas for re-doing the agroecological assessment of the lands and solving the actual agroecological problems of their use in agriculture for greening the development of the agricultural area in the Karabakh economic region. In the economic region, the main approach is given to methodological issues of agro-ecological assessment of soil quality, greening of efficient use of agricultural land, agro-ecological analysis of anthropogenic dynamics of soils, regional integration of assessment of agro-ecological quality of soils. In the design of agroecosystems in the Karabakh economic region, the agroecological approach of the differentiation of the area according to the soil-climate factors, the evaluation of the soil taking into account the geomorphological and climatic factors is given. At the same time, the importance of cadastral assessment and accounting of the modern ecological condition of the region's land resources, as well as the issues of their effective use and protection are explained.

In the article, in order to ensure the development of the agrarian sector in the region, the importance of the complex agro-ecological re-evaluation of land resources, ways to eliminate the main indicators of land degradation and ecological requirements for the cultivation of plants, determination of territorial units characterized by variability of natural and climatic conditions, agro-production grouping of elementary areas of agro-landscapes and according to the agro-ecological assessment of the area, the ways of organizing the efficient use of land were investigated.

Methodology. Generalization, historical, statistical, systematic analysis, and comparison methods were used to prepare the article.

Research results. Environmental and economic stability may become more challenging in the future due to increasing anthropogenic pressure on agroecosystems in the economic region and poor infrastructure. Due to intensive land use, frequent erosion, river floods, and environmental pollution in the region can lead to a decline in the quality of agricultural land. Also, anthropogenic activities in the region can have a negative impact on the state and development of agroecosystems and the sustainable development of agriculture in the region, to optimize which it is considered necessary to improve and update the methods and technologies used in agriculture.

The scientific novelty of the research. It is necessary to apply agroecological concepts and principles in the redesign, development, and management of sustainable agricultural systems in the economic region. The development of agroecosystems in the region should be ensured by alternative agricultural methodologies and approaches that combine the socio-economic and historical context of agriculture. The production of organic agricultural products, which do not harm human health and the natural environment, should be carried out, and the ecological condition of the soil should also be monitored regularly.

Keywords: greening, agriculture, environmentally friendly product, agro-industrial complex, assessment.

In cites: Mehdiyeva Valida, Khalilov Ilgar, Eminov Farhad (2023). Greening and agroecological assessment of the agricultural sector of the Karabakh region. *Visnyk of V. N. Karazin Kharkiv National University, series "Geology. Geography. Ecology"*, (59), 298-306. <https://doi.org/10.26565/2410-7360-2023-59-22>

Introduction. In 2020, the Azerbaijani army liberated the historical territories of Karabakh and Eastern Zangezur, which had been under the occupation of Armenia for almost 30 years, and this year went down in the history of the country as the year of Victory. Part of the territories liberated from occupation is the territory of the Karabakh economic region, located between the Araz River and the southeastern part of the Lesser Caucasus, the western part of Azerbaijan, including the Karabakh plain, starting from the Karabakh ridge. The Karabakh economic region,

which has unique rich natural and geographical features, including fauna and flora, valuable soil and water resources, natural landscapes, and an area of 8.99 thousand km², covers mountainous, low-mountainous, and flat territories in relief. The rivers Tartar-chay, Gargarchay, Khachinchay, Gulablychay, Kondelanchay, Guruchay, Gozluchay, and Cheraken, flowing through the territory of the economic region and belonging to the Kura-Aras river basin, are of great importance in the water supply of the region and irrigation of agricultural land.

On the territory of the Karabakh economic region, soil types of various productivity are common, including gray, forb-gray, chestnut, light chestnut, mountain chestnut, and mountain gray-brown soil types. The climate is dry desert in the plains located along the Karabakh plain and the Araz River, with dry summers in the low mountains and foothills. The average monthly temperature on the plains and in the foothills is 0-1°C in January and 24-25°C in July. The average annual precipitation is 400-800 mm [11,18,19].

The problems of the greening of agricultural plants in the agrarian sector in the territory of the Karabakh economic region and the modern agro-ecological assessment should be taken into account, taking into account the factors of soil productivity (lack of nutrients and microelements) in the structure. In addition, there is a violation of the salt balance, physical and physicochemical properties of the soil, the development of pathogenic microflora, the prolifera-

tion of pests and harmful weeds, and a change in pH in a direction unfavorable for plants.

1. Problems of ecologicalization of agricultural plants in the Karabakh economic region

The basis of the economy of the Karabakh economic region is agriculture. The reason for this is that there are different types of soil suitable for agriculture in terms of productivity in the region. In 2015, the cultivated area for agricultural purposes in the economic region was 226581 ha, but this indicator increased slightly and reached 227332 ha in 2021. Accordingly, the area of cultivated land was 111187 ha in 2015 and 102136 ha in 2021 for cereals and legumes, 13721 and 13094 ha for potatoes, vegetables, and melons, and 5608 and 6428 ha for orchards and berries. In 2015, the cotton cultivation area in the economic region was only 3187 ha, and in 2021, this number increased by 9 times and reached 27855 ha (fig. 1).

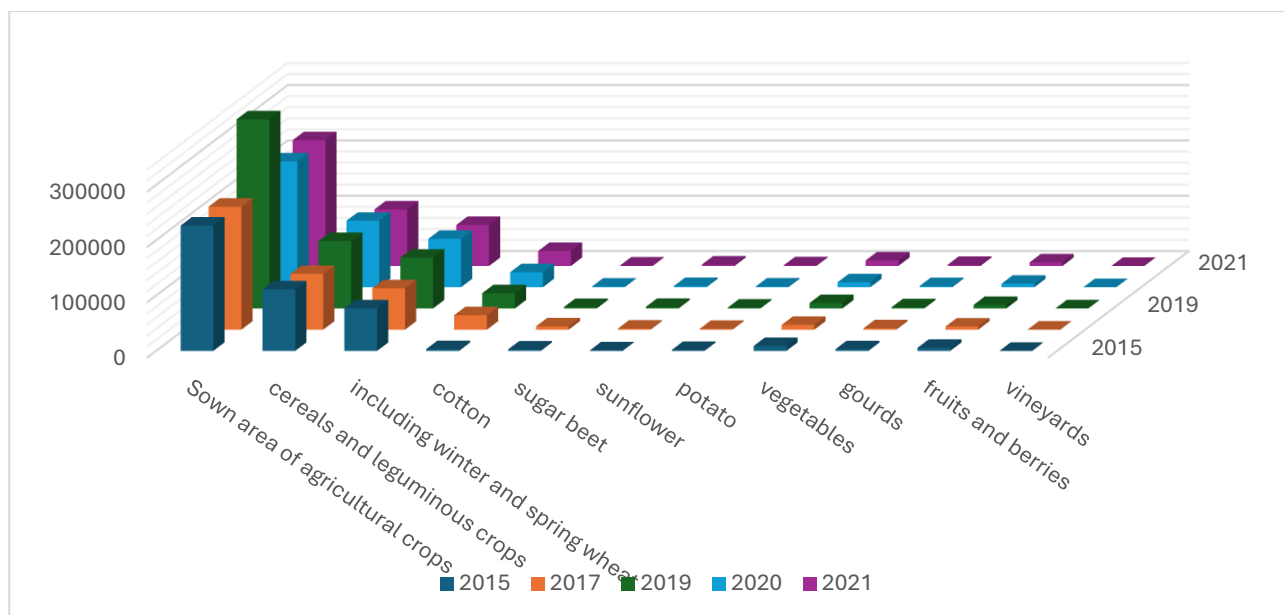


Fig. 1. Cultivated area of agricultural crops in the economic region, ha [20]

In total, 406180 tons of grains and legumes were harvested from cultivated land in 2015, and this figure dropped to 389840 tons in 2021. At the same time, the yield of sugar beet decreased by about 3.5 times. However, this decrease was mainly due to a 3-fold reduction in beet acreage. Among other products mentioned above, there was an increase in the yield of cotton, vegetables, fruits and berries, grapes and a decrease in the harvest of potatoes and melons (Fig. 2).

In 2021, there were 300,213 heads of cattle, 747,231 heads of sheep and goats, 1,742,482 heads of birds, and 32,006 bee families in the region. Compared to 2015, the number of cows and buffaloes increased from 135,763 to 139,405 in 2021, the number of birds increased from 1,645,624 to 1,742,482, bee families increased from 10,642 to 32,006, and the number of sheep and goats decreased from 851033

heads to 747231 heads, respectively. During this period, meat slaughter increased from 21,776 tons to 26,910 tons, milk production increased from 238,585 tons to 311,007 tons, and egg production increased from 67,469 units to 101,221 units (Fig. 3 and 4).

Undoubtedly, after the clearance of land in the region from mines and unexploded ordnance, both the sown area and the quantitative and qualitative indicators of cultivated products will increase. Agricultural production is carried out under irrigation conditions on the plains, and in hilly and foothill areas, mainly in rainfed conditions [6].

On the rivers flowing through the territory of the economic region, reservoirs were built and put into operation to provide cultivated fields with irrigation water. Before the occupation, grain growing, viticulture, cotton growing, vegetable growing, fruit grow-

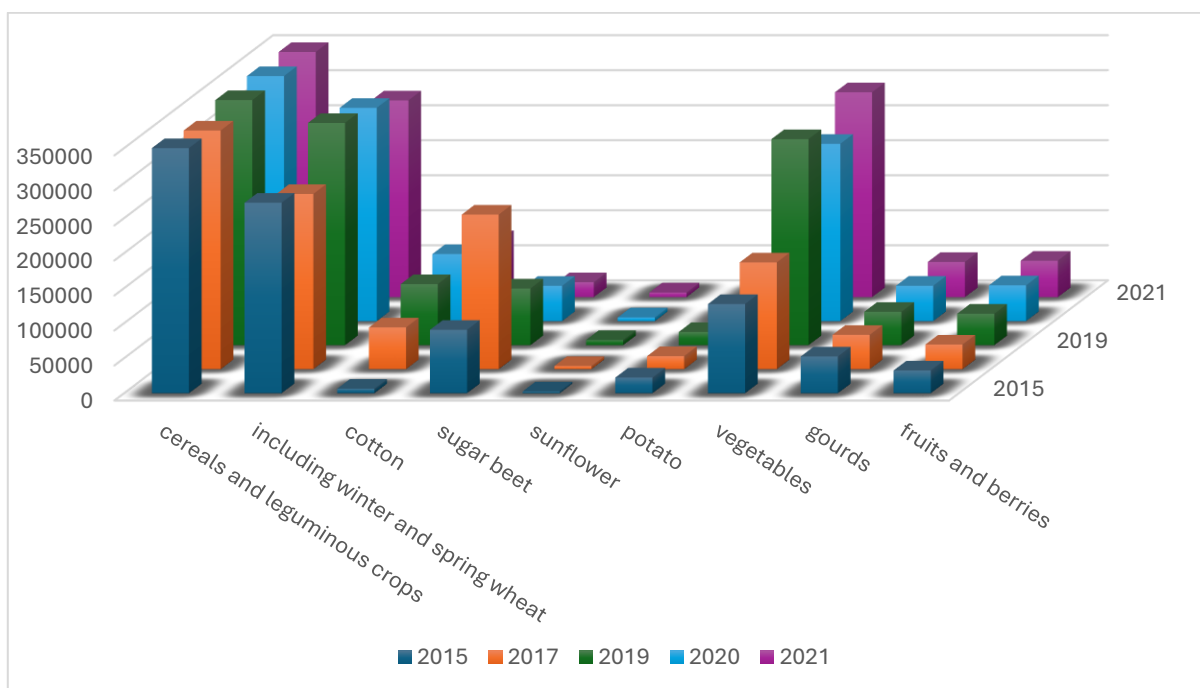


Fig. 2. Production of agricultural products, tons

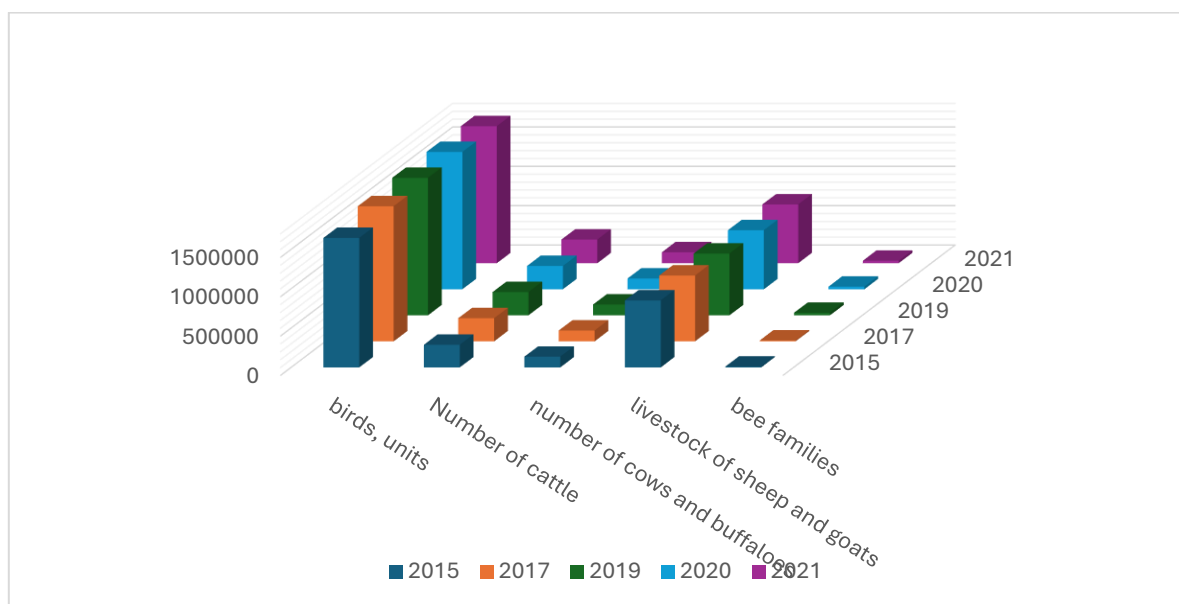


Fig. 3. Number of animals and birds and livestock production in the economic region

ing, cattle breeding, sheep breeding, poultry breeding, pig breeding, horse breeding, beekeeping, and cocoon breeding were widely developed in the economic region. During the same period, the problem of producing environmentally friendly agricultural products in the economic region arose, which was associated with the widespread use of chemicalization [14, 20].

The current global environmental crisis and food security problems have set the country the task of transitioning to a sustainable development strategy. The most important direction of this strategy is to provide the entire population of the country with environmentally friendly agricultural products. Obtai-

ning environmentally friendly (green farming) crop and livestock products is one of the most important tasks in the Karabakh economic region liberated from occupation [15].

The production of high-quality, environmentally friendly crop and livestock products is one of the prerequisites for the sustainable development of the economic region. It is known that environmentally safe agricultural products are products that comply with general hygienic, technological, and toxicological standards adopted for their various types (production-processing-consumption) and do not have a negative impact on human health, animals, and the environment. Simply put, any home garden where we grow

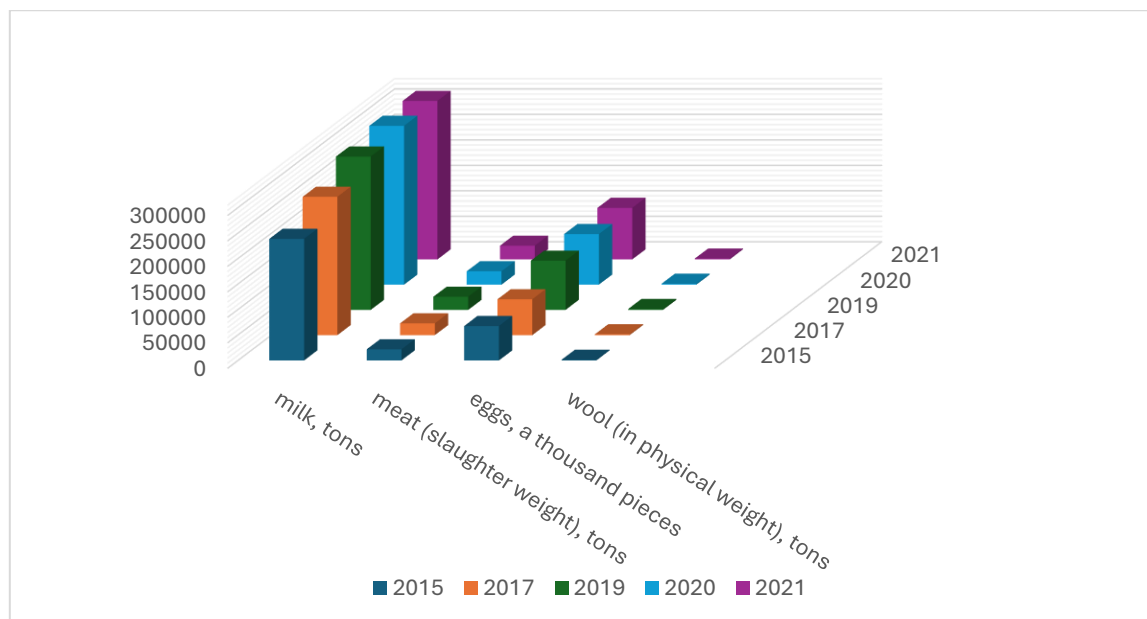


Fig. 4. Production of livestock products [20]

our own produce gives us more confidence than what we buy in the supermarket, and this is natural because our own produce is grown without pollution factors, etc. it does not affect us.

To obtain ecologically safe agricultural products in the territory of the Karabakh economic region, it is necessary to conduct scientific research in agroecosystems in order to have reliable preliminary information on the ecological and toxicological state of the soil as a result of the intensive use of agrochemical substances (fertilizers, pesticides, ameliorants, etc.). In our opinion, the first work on the released land plots of the economic region should begin with an assessment of the ecological and toxicological state of agroecosystems, primarily the soil cover. With proper consideration of environmental requirements, it is possible to achieve a desire to increase the productivity of cultivated plants and animals. To do this, it is important to implement in the economic region:

1. Apply the scientific foundations of the greening of agriculture in the territory of the economic region;
2. Apply modern methodological approaches to agroecological land assessment;
3. Define the principles of agroecological assessment of arable land;
4. Determine the agroecological assessment of plants [3].

Agricultural products in the territory of the Karabakh economic region are diverse. There is great potential here to increase the production of grain crops, grapes, cotton, potatoes, melons, fruits and vegetables, meat, and dairy products, which are produced to meet the biological, material, and other needs of the population [5].

The starting point in solving the problem of gre-

ening agriculture in the territory of the Karabakh economic region, cleared after liberation from occupation, is the development of a system of agroecological assessment of agricultural plants. To determine agro-ecological areas of plant cultivation in the territory of an economic region, it is necessary to determine and clearly indicate their requirements for agroclimatic, soil, geomorphological, lithological, hydrological, and other conditions. At the same time, in addition to quantitative estimates of the productivity of agricultural crops grown in the economic region, the quality side of the product should be no less important.

2. Agro-ecological assessment of the soil and agricultural plants of the Karabakh economic region.

All aspects of the agroecological assessment of the lands liberated from the occupation of the Karabakh economic region and the plants grown on them should be carefully studied and evaluated by new scientific research. Some criteria for the agroecological assessment of crops are currently descriptive and based on practical experience without deep experimental research. Nevertheless, the extensive factual material collected in the region will allow us to effectively solve this problem of the formation of modern farming systems [1, 10]. In order to implement the production of environmentally friendly agricultural products, it is advisable to implement the following measures on the territory of the economic region:

- evaluate the quality of agroecosystems;
- rechecking the production and processing of environmentally friendly agricultural products;
- evaluate the quality of environmentally friendly agricultural products;
- to detect contaminants in food products;
- carry out certification of food products;

- strengthening state support for the development of small and medium-sized businesses in the field of food production.

When evaluating agricultural plants in the territory of an economic region, one should take into account the ecological requirements of plants for metabolism, as well as the requirements associated with the technological features of their cultivation and environmental impact. It is known that the agrotechnical properties of the soil are based on an assessment of the basic properties of the soil in terms of their suitability for growing plants. To determine the agrotechnical properties of soils, fixed and regulated indicators are distinguished [8, 13]. The agrophysical properties of soils in an economic region should be determined by a general description of the physical state of soils, their granulometric and aggregate composition, structural state, specific gravity, mass density, porosity, air, water, thermal, electrical, and radioactive properties.

The biological activity of soils on the territory of an economic region is expressed by the general manifestation of the activity of the biochemical processes occurring in them. These processes characterize the magnitude and direction of the transformation of substances and energy under the influence of living organisms in the soil. Soil biological activity indicators can be used to check the condition of the soil. When soils are contaminated with small amounts of organic compounds, an increase in some indicators of biological activity is observed. Because here the groups of microorganisms involved in the processing of additional substrates develop more intensively [6, 9].

The influence of plants on the soil in the territory of the economic region should be well studied. It is known that plants are the main source of soil nutrition with organic matter. Without organic matter, it would be impossible to form a fertile layer of the soil horizon - bio humus, and this, in turn, would make it impossible for the presence of flora and fauna on the surface of the earth. Plant roots serve as a hardening material for many types of soils, and prevent soil erosion. Plants can remove a significant amount of excess salts from the soil, and can also change the acid-base ratio of the soil. Trees around agricultural land have a protective effect, protecting the soil from wind erosion. Plants are excellent fertilizers and the basis for fertile soil layers. They are also food for many living organisms, including bacteria and fungi. Provision of organic matter is especially important in sandy and sandy loamy clay soils [3, 4].

It is known that the requirements of plants for heat, light, moisture supply, and temperature regime are different. Usually, agroecological assessment of plants begins with the determination of the length of the growing season. The overall assessment of the heat needs of plants is determined by the sum of

active temperatures (above 10°C) during the growing season. This trait can vary greatly not only between plants but also between different varieties of the same crop. The need for heat is calculated for almost all crops, their varieties, and hybrids. On the territory of the Karabakh economic region, the active temperature above +10 C ranges from 1500 to 3500 degrees from the highlands to the plains, which affects the growth of various crops (cereals and legumes, fruits and vegetables, melons, cotton, grapes, other industrial crops) is considered important for cultivation.

3. Ecological problems of agriculture in the Karabakh economic region and ways to solve them.

The cultivation of ecologically high-quality agricultural products in the occupied territories of the Karabakh economic region is closely related to the ecological state of the local lands. The military actions carried out on the territory of the economic region for almost 30 years have spoiled the ecological state of the lands and caused their degradation. It is known from studies that due to soil erosion, salinization and waterlogging of sites, plant nutrition disturbance through the root system is accompanied by a decrease in yield and a deterioration in the quality of agricultural products. From studies conducted in foreign countries, it is known that in wheat grain grown in eroded areas, the amount of protein, starch, microelements decreases and the nutritional quality of grain deteriorates. When the environment for growing plants is contaminated, the quality of the product deteriorates significantly.

The environment is mainly polluted by waste from industrial enterprises, pesticides used in agriculture, and wastewater from livestock farms and complexes. Environmental pollution can lead to the accumulation in plant tissues of a large amount of nitric acid salts, pesticide residues, heavy metals, and radionuclides. Under the influence of pollutants and xenobiotics, the quality of plant food raw materials and food products decreases. Plant products are of poor quality, often harmful and toxic, and even pathogenic [12].

As a rule, the distribution of toxic substances in the body of animals is uneven. They depend on the physicochemical properties of pollutants and other factors. So, DDT is mainly concentrated in adipose tissue, lead - in the liver and kidneys, cadmium - in the kidneys, radioactive iodine - in the thyroid gland, and strontium - in the bones. Many chemical compounds that migrate through the food chain are transformed into new forms. Some of them are neutralized, while others, on the contrary, become more harmful. The concentration of persistent chemicals and long-lived radionuclides is increasing in the last links of the food chain, including in the human body.

Under the influence of pollutants and xenobiotics in the body of animals, the quality of livestock

products is reduced. Food raw materials and food products of animal origin are often of poor quality, even harmful or pathogenic [4, 5].

With this in mind, the lands on the territory of the economic region must be studied in detail, and scientifically substantiated, so that the quality of the products grown on them meets environmental, hygienic norms and standards.

The presence of heavy metals that accumulate in the soil during the conflict and have migratory properties, which are considered a source of danger to the living world, has a negative impact on the production of agricultural products and its quality in the economic region. Studies show that heavy metals are known to be the most dangerous pollutants. The most common of them are lead, mercury, cadmium, arsenic, zinc, nickel, etc. About 90% of heavy metals released into the environment accumulate in soils. They then migrate to natural waters, are taken up by plants, and enter the food chain. Lead, mercury, cadmium, arsenic, and zinc are considered the main pollutants because their anthropogenic accumulation in the environment is particularly high. These elements have a high affinity for physiologically important organic compounds and are able to suppress the most important metabolic processes, and inhibit growth and development [7]. In agricultural production, this leads to a decrease in productivity and a deterioration in product quality. A person's risk of getting sick varies depending on the allowable between of heavy metals that he can take with food, for example, lead-3 mg, cadmium-0.4 mg, and mercury-0.3 mg per week. Although these levels are arbitrary, they serve to control the content of heavy metals in foods [3, 4].

In general, there is no such thing as nitrate agricultural products. Because they are the main source of nitrogen in plant nutrition. To obtain high-quality agricultural products on the lands of the economic region, it is necessary to introduce mineral nitrogen fertilizers and organic substances into the soil. The problem of nitrates in agricultural products is one of the most urgent problems of our time. The illiterate use of high and ultra-high doses of nitrogenous minerals and organic fertilizers leads to the fact that an excess of nitrogen in the soil causes large amounts of nitrates to enter the plants. Nitrates are salts of nitric acid. Salts of nitric acid are used as fertilizers in the form of sodium nitrate, potassium nitrate, ammonium nitrate, and calcium nitrate. Nitrates are present in all environments - soil, water, and air. By themselves, nitrates are slightly toxic, but under the action of microorganisms or during a chemical reaction they are reduced to nitrites, which are dangerous to humans and animals. Among the crops cultivated in the region, the most nitrates are collected in table beet, lettuce, spinach, dill, etc. Therefore, in order to reduce the amount of nitrates in food, it is important to

choose the right methods of cultivation, and storage [1, 16].

In soils, nitrites are formed as a result of the activity of nitrifying and denitrifying microorganisms as an intermediate product of ammonia oxidation and nitrate reduction. Under normal conditions, their amount in plants and water is small. However, when fresh vegetables are stored at room temperature, microbial conversion of nitrate to nitrite can occur, leading to an increase in the content of the latter.

For the normal productivity of agroecosystems in all regions of Azerbaijan, including the Karabakh economic region, in addition to fertilizers, plant protection products from weeds, diseases, and pests, which are called pesticides, are also used [2]. Of particular concern is the possibility of contamination of soil, water, and plants, including agricultural crops and products of their processing with residual amounts of pesticides. Pesticides can cause cancer in humans. About 70% of the compounds used enter the human body through meat, milk, and eggs, and 30% through plant foods. The main reason for the accumulation of residual amounts of pesticides in products is the violation of the rules for their use. For the development of green farming in the economic region, the use of individual effective methods of plant protection, including the integrated use of chemical, biological, and agrotechnical measures, can provide comprehensive plant protection.

Dioxins are among the harmful substances of technogenic origin that harm agricultural products. The most important chemical properties of dioxins are extreme stability in strong acidic and alkaline solutions, and high resistance to oxidizing agents. Dioxins are strongly associated with soil particles, so they are poorly washed off by rain. Dioxins are concentrated in the main upper 15-meter soil layer. The sources of dioxin formation and the ways of their entry into inanimate and living nature are very diverse. Their appearance in the environment is primarily associated with the production and use of organochlorine compounds and their disposal. Dioxins enter the air with smoke from the burning of industrial and domestic waste, as well as with vehicle exhaust gases. Accumulation of dioxins is observed mainly along food chains. Most dioxins are readily absorbed from the gastrointestinal tract and skin. Dioxins are practically not excreted from the human body [5, 17].

Thus, increasing the efficiency of crop production and animal husbandry, thereby solving the problem of providing food to the rapidly growing population of the country, can be solved by polluting the soils of the economic region and developing degradation processes in them, eliminating intense and large-scale pollution and depleting the natural environment. Otherwise, as a result of an increase in the content of toxic elements and compounds in the soils of

the economic region, the quality of food products may deteriorate. Heavy metals collected in soil and plants affect the environment in the economic region, and pose a potential threat to human health due to contamination of drinking water and agricultural land. These threats are exacerbated by watercourses that transport pollutants to other parts of the economic region.

Sustainable development of the Karabakh economic region, as well as environmental security, can only be achieved by preserving natural ecosystems and ensuring the proper quality of the environment. This can be achieved through the formation and consistent implementation of a unified state policy in the field of environmental protection and rational use of natural resources.

The state policy in the field of environmental protection and efficient nature management is based on the following basic principles, the implementation of which will stimulate the development of green farming in the Karabakh economic region and the preservation of agro-ecological conditions:

- sustainable development of the economic region, equal attention to its economic, social and environmental component and prevention of land degradation;

- minimization of negative environmental consequences and protection of public health during the period of economic growth, which will occur as a result of promising economic activities in the economic region;

- refusal to implement economic and other projects implemented on the territory of the eco

- compensation for damage caused to the environment as a result of violation of the legislation of the Republic of Azerbaijan on the use of natural resources in the territory of the economic region on a paid basis and on environmental protection;

- ensuring the active participation of environmental non-governmental organizations, self-government bodies and business circles operating in the territory of the Karabakh economic region in the preparation, discussion, adoption and implementation of decisions in the field of environmental protection and rational nature management.

We hope that in the near future the concept of greening agriculture will be fully implemented in the Karabakh economic region, cleared of mines and unexploded ordnance, the effectiveness of environmental protection measures will increase, and the population will be able to preserve nature for themselves.

Conclusion

It is necessary to comply with environmental norms and standards applied in agriculture and animal husbandry in order to have a high quality of agricultural products grown in the territory of the

Karabakh economic region and grown in the future, and to grow environmentally friendly agricultural products. On the territory of the economic region, the activities of the biogeochemical food chain, the quality of crop and livestock products are to a certain extent influenced by climatic (microclimatic), hydrological, biocenotic and anthropogenic factors. In the event of drought, heavy rains, hail and floods, adverse weather and climatic conditions, mass diseases of plants and animals, and man-made environmental disasters, the conditions for the development of crop and livestock production can deteriorate sharply. This will lead to a decrease in the scale of production and a deterioration in the quality of agricultural products of plant and animal origin.

In general, the high anthropogenic pressure on the environment, the fragility of local ecosystems in the regions, the population density in the future, and weak infrastructure are threats to environmental and economic stability. However, the scale of the anthropogenic impact is such that a significant part of the land, including agricultural land, may become unusable as a result of various negative processes and phenomena occurring in the economic area: water and wind erosion, flooding, the threat.

At the same time, a possible technogenic impact on the territory of the economic region will have a negative impact on the state and development of agroecosystems, which makes it necessary to solve the problem of developing methods and technologies to prevent or reduce the negative impact of technogenic factors in order to ensure the sustainable development of agricultural production. Land degradation in the territory of the economic region occurred as a result of the impact of natural and anthropogenic processes that caused a change in the function of the land, the natural and economic value of soils, as well as the quantitative and qualitative deterioration of its. The composition of humus in the soil, optimization of its quality, proper use of chemicals in the soil are the most important conditions for growing environmentally friendly agricultural products.

It is necessary to use microbiological fertilizers in new areas, industrial processing of household waste, composting and processing of animal waste, industrial technology for the production of environmentally friendly organic fertilizers based on biotechnology, contributing to the production of environmentally friendly agricultural products.

Successful development of agriculture and animal husbandry in the economic region, improving the quality of agricultural products is possible when implementing measures based on the results of an objective environmental assessment of agrobiogeocenoses, lands suitable for grazing and farming.

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Authors Contribution: All authors have contributed equally to this work.

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У статті представлені сучасні ідеї щодо переробки агроекологічної оцінки земель та вирішення актуальних агроекологічних проблем їх використання в сільському господарстві для екологізації розвитку сільськогосподарського району Карабаського економічного району. В економічному районі основний підхід приділяється методичним питанням агроекологічної оцінки якості ґрунтів, екологізації ефективного використання сільськогосподарських угідь, агроекологічного аналізу антропогенної динаміки ґрунтів, регіональної інтеграції оцінки агроекологічної якості ґрунтів. ґрунти. При проектуванні агроecosystem Карабаського економічного району дається агроекологічний підхід диференціації території за ґрунтово-кліматичними факторами, оцінка ґрунту з урахуванням геоморфологічних і кліматичних факторів. При цьому роз'яснено важливість кадастрової оцінки та обліку сучасного екологічного стану земельних ресурсів регіону, а також питання їх ефективного використання та охорони. Для забезпечення розвитку аграрного сектору регіону розглянуто важливість комплексної агроекологічної

переоцінки земельних ресурсів, шляхи усунення основних показників деградації земель та екологічні вимоги до вирощування рослин, визначення територіальних одиниць, що характеризуються мінливістю природно-кліматичних умов, досліджено агровиробниче групування елементарних ділянок агроландшафтів та за даними агроекологічної оцінки території, шляхи організації ефективного використання земель. Екологічна та економічна стабільність може стати більш складною у майбутньому через посилення антропогенного тиску на агроєкосистеми в економічному регіоні та погану інфраструктуру. Через інтенсивне землекористування, часті ерозії, розливи річок, забруднення навколишнього середовища в регіоні можуть призвести до погіршення якості сільськогосподарських угідь. Також антропогенна діяльність у регіоні може негативно впливати на стан і розвиток агроєкосистем та сталий розвиток сільського господарства регіону, для оптимізації якого вбачається за необхідне удосконалити та оновити методи і технології, що використовуються в сільському господарстві. Необхідно застосовувати агроекологічні концепції та принципи при реконструкції, розвитку та управлінні стійкими сільськогосподарськими системами в економічному регіоні. Розвиток агроєкосистем регіону має забезпечуватися альтернативними сільськогосподарськими методологіями та підходами, які поєднують соціально-економічний та історичний контекст сільського господарства.

Ключові слова: екологізація, сільське господарство, екологічно чистий продукт, агропромисловий комплекс, оцінка.

Внесок авторів: всі автори зробили рівний внесок у цю роботу

Надійшла 5 жовтня 2023 р.
Прийнята 9 листопада 2023 р.