ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ

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ENVIRONMENTAL EXTERNALITIES OF THE AGRICULTURAL ACTIVITY

Abstract. *The article highlights the main sources and the effects of the influence of agriculture on the environment. Environmental externalities of the intensification of farming and the development of livestock breeding in Ukraine are analysed. The ways to reduce negative impact of the agricultural production on the environment are identified.*

Keywords: *agriculture; crop production; livestock breeding; environmental externalities; environmental pollution; intensification of farming; waste generation; waste management.*

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ЕКОЛОГІЧНІ ЕКСТЕРНАЛІЇ СІЛЬСЬКОГОСПОДАРСЬКОЇ ДІЯЛЬНОСТІ

Анотація. *У статті висвітлено основні джерела та наслідки впливу сільського господарства на навколишнє природне середовище. Проаналізовано екологічні екстерналії інтенсифікації землеробства та розвитку тваринництва в Україні. Визначено шляхи зменшення негативного впливу сільськогосподарського виробництва на довкілля.*

Ключові слова: *сільське господарство; рослинництво; тваринництво; екологічні екстерналії; забруднення навколишнього природного середовища; інтенсифікація землеробства; утворення відходів; утилізація відходів.*

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ЭКОЛОГИЧЕСКИЕ ЭКСТЕРНАЛИИ СЕЛЬСКОХОЗЯЙСТВЕННОЙ ДЕЯТЕЛЬНОСТИ

Аннотация. *В статье освещены основные источники и последствия воздействия сельского хозяйства на окружающую природную среду. Проанализированы экологические экстерналии интенсификации земледелия и развития животноводства в Украине. Определены пути уменьшения негативного воздействия сельскохозяйственного производства на окружающую среду.*

Ключевые слова: *сельское хозяйство; растениеводство; животноводство; экологические экстерналии; загрязнение окружающей природной среды; интенсификация земледелия; образование отходов; утилизация отходов.*

Urgency of the research. Agriculture is one of the main sectors of the national economy, which is an important source of provision of population with food and the processing industry with raw materials, as well as a powerful factor affecting the environment. According to the scientists' assessment this industry is among the leaders by the level of the anthropogenic pressure. Considerable damage to the environment was caused by land chemicalization and reclamation, use of heavy machinery, high concentration of production, particularly in livestock breeding.

Target setting. Intensive agricultural production led to soil depletion, destruction of natural vegetation, reduction of species diversity of wildlife, increase in waste production and as a result – environmental pollution. Thus, the necessity to strengthen environmental protection and ensure ecologization of agricultural production is increasing. To reduce the technological load on the environment, finding ways of ecological restructuring of agrosphere becomes particularly important, as well as working out and practical implementation of measures aimed at ensuring sustainable, environmentally balanced and effective development of agricultural production.

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Actual scientific researches and issues analysis. Many domestic scientists addressed environmental issues in agriculture in their studies. In particular, O. V. Dorofeev [1] analyzes the effects of the intensification of farming on the ecological balance of the environment and proves the feasibility of alternative ecological systems of the agriculture. O. M. Zhukorskyi, O. V. Nykyforuk, N. P. Boltyk [2] study the harmful influence on the air space caused by the farms producing dairy products. The article by M. M. Kocherha is dedicated to the ecological-economic problems of the agricultural land use [3]. Y. M. Makovetska [4] reveals the peculiarities of waste generation and waste management in rural areas.

Uninvestigatigated parts of general matters defining. However, there remain many not highlighted issues of theoretical and applied nature, concerning the impact of agricultural production on environmental pollution and proof of the ways to substantially reduce destructive loads of agrarian management on the environment, breadth and complexity of which require continued scientific research.

The research objective. The purpose of this article is to study theoretical and practical aspects of the impact of agricultural production on environmental pollution in Ukraine and substantiate the ways of making agriculture environmentally friendly.

The statement of basic materials. Significant and diverse impact of agricultural activity on the environment can be divided into two groups: the impact of crop production and livestock breeding.

The impact of farming on the natural environment depends on the composition, placement, rotation and method of cultivation of agricultural crops; the overgrowing of arable land with perennial weeds and shrubs; the disturbance of areas above the acceptable limits; the burning of crop residues; the quantity and type of fertilizers; the use of pesticides and insecticides; the mismanagement of storage and transportation of mineral fertilizers and pesticides; the lack of water stands.

Removal and transfer of topsoil; irrational organization of land melioration; damage of forest stands, illegal felling of trees; quarrying on agricultural lands; failure to use land for agricultural production and their transfer for the construction of real estate objects for various purposes have a significant impact on the environmental pollution.

The factors of influence on livestock breeding include production of waste that can get into the soil, water and atmosphere; unregulated animals grazing, which leads to degradation of pastures, deterioration of soil characteristics and development of erosion processes; dead animals near the farms.

In addition, the environment is polluted by vehicles and agricultural machinery; mechanical tillage; missing or unreliable operation of purifying facilities. The presence of natural processes also increases the negative impact of crop production and livestock breeding on the environment. The consequences of influence of the agricultural production on the environment are reflected in the table 1.

As at 1st of January 2016 agricultural lands cover 70.8% of the territory of Ukraine (42.7 million ha), including arable land – 53.9% (32.5 million ha) (while the environmental rate is 40%) [5]. During the period of land reform in Ukraine a significant number of problems in the sphere of land relations were not only unresolved, but even escalated [6]. The ecological state of Ukrainian land resources in the past decades has significantly deteriorated.

Land degradation processes, among which the most serious ones are erosion (about 57.5% of the territory), pollution (about 20%), flooding (about 12%), have spread on the territory of Ukraine. Nutrient content of soils has decreased and annual losses of humus are 0.65 tons per 1 ha [6].

Table 1

The consequences of influence of the agricultural production for the environment

Activity	Elements of the production cycle in agriculture	Consequences of influence for the environment
1	2	3
Plowing, planting, tillage, harvesting and processing of agricultural products	Use of mobile power tools	Chemical, mechanical and acoustic pollution of the atmosphere, liquid petroleum pollution; soil compaction (as a result of pressure, dynamic impact and vibration).
	Plowing the soil	Increased concentration of heavy metals in food chains.
	Tillage	Development of water, wind and technical erosion; plow sole formation; increasing traction as a result of soil compaction.

Continuation of Table 1

1	2	3
	Use of fertilizers, ameliorants and plant protection tools	Climate change, formation of acid rain, increased concentration of nitrates (nitrites) in the food chain, increased corrosion. Water and soil pollution with chemicals and pathogenic organisms; accumulation of pesticides in the body through the food chain.
	Processing and collection of root crops and tubers	Development of erosion, compaction of topsoil, removal of land from the field with production; damage to the tubers and the related loss of agricultural products during storage.
	Harvesting of grains and fodders	Improvement of conditions for pests due to loss of production; loss of green mass with its loading, crushing and damaging of grains, death of animals caused by cars.
	Drying, cleaning, sorting and storage of grains and seeds, grass meal reception	Environmental pollution by toxic gases evolved in the drying process, obtaining seed crops not clean enough and contamination; damage and loss of grain products during storage.
	Operating the fleet of machines and tractors	Environmental pollution by metal products, petroleum, mechanical abuse of soil.
	Conducting melioration	Destruction of topsoil, erosion, waterlogging and dehumidification.
Fattening animals	Keeping animals	Pollution and contamination of the environment with manure, air pollution by gases produced during animal vital processes and decomposition of manure; pollution of natural water by livestock farm runoff.
	Grazing animals	Depletion of pastures, manure contamination (forests, ponds, ravines, pastures)
	Washing animals, cleaning the rooms and disinfection; manure water-wash	Environmental pollution (discharge of flowing water into the water and soil)
	Preparation of feed, washing dishes and equipment	
	Mechanization of production processes in animal breeding	

Source: systematized by the author

Producers simply ignored the process of crop rotation in order to reach quick profits. There was an increase in the share of acreage allotted for industrial crops (sunflower, maize, rape, soya) from 11.6% in 1990 to 15.4% in 2000, 20.2% in 2005 and 31% in 2014 and 2015. So, if in 1990 soil-exhausting sunflower occupied 1636 thousand ha, in 2000 it occupied already 2943 thousand ha, in 2005 – 3743 ha, and in 2014 – 5257 ha; in 2015 its crops slightly decreased to 5105 thousand ha [5; 7].

A positive trend in increasing volumes of mineral fertilizers while reducing volumes of organic fertilizers is of concern. According to the State statistics service of Ukraine, 278.71 thousand tons of mineral fertilizers were used in 2000, 557.92 thousand tons were used in 2005 and 1469.01 thousand tons were used in 2014. Meanwhile, the use of organic fertilizers was 28410.1 thousand tons, 13245.8 thousand tons and 9860.9 thousand tons, respectively [5; 8], due to the reduction in the number of animals in the agricultural sector of Ukraine and a significant increase in the cost of organic fertilizers.

Chemical means of plant protection are one of the biggest factors of the environmental pollution. In 2014 the protection of agricultural crops against harmful organisms was made on the area of 44.4 million ha (in 2013, 46.8 million ha). Biological method was applied only on the area of 2.2 million ha [9]. There is a tendency to increase the use of pesticide in Ukraine in recent years due to the reduction of the agronomic methods of weed control. In particular, 37.6 thousand tons of pesticides were used in 2014 [9], that is significantly higher than the figures of the previous decade (for example, 12.0 thousand tons and 25.6 thousand tons were used in 2004 and in 2009, respectively) [5].

Besides damaging soils, agricultural production also pollutes the atmosphere with harmful emissions. Thus, volumes of air emissions of pollutants by stationary sources increased from 61.0 thou-

sand tons in 2009 to 89.8 thousand tons in 2013, slightly decreasing in 2014 (77.0 thousand tons). Volumes of carbon dioxide emissions were 566.4 thousand tons; 974.1 thousand tons; 775.9 thousand tons, respectively [5; 10].

The study of air emissions from stationary pollution sources by production and technological processes indicates a growing number of enterprises in agriculture and forestry, land use and change of forest biomass, which pollute the atmosphere, from 622 in 2009 to 796 in 2014, as well as emission volumes from 52690.7 tons to 64792.4 tons, respectively. On average, one enterprise emits more than 80 tons of harmful substances into the atmosphere. Emissions from the cultivation of crops are growing both with fertilizers (except manure) (129.5 tons (15 enterprises) in 2009 and 212.2 tons (35 enterprises) in 2014) and without them (1.9 tons in 2009 (5 enterprises) and 234.4 tons (9 enterprises) in 2014) [5; 10].

The agriculture, in particular crop production, annually generates a large amount of various wastes and residues [4]. For the period from 2010 to 2014 the largest quantity of the agricultural waste (except for pesticides and toxic chemicals that became obsolete or forbidden for use) was in 2012 amounting to 11.75 million tons. This figure decreased to 9.45 million tons in 2014. The waste of obsolete or forbidden pesticides and agrochemicals were 121.7 thousand tons and 11.2 thousand tons, respectively [10].

The largest volumes of emissions in livestock breeding in Ukraine (pollutant chemicals (without greenhouse gases), microorganisms, dust) are caused by poultry industry (72%); pig breeding (19%), other sectors (9%). The factors of such a negative impact are both animals themselves and their waste products, and also all production and business processes on the farms [2].

Different categories of pollutants fall into the airspace as a result of the animal farms activities. In Ukraine the largest figures of pollutants from agricultural activities into the environment in 2013 were for methane CH_4 (5.7%) and ammonia NH_3 (77.5%) [10].

According to the State statistics service of Ukraine, there is a tendency in increasing of wastes, associated with the combustion of animal carcasses (from 4.8 tons in 2010 to 13.7 tons in 2014). Enteric (intestinal) fermentation; cleaning, storage and use of manure and also organic substances have a significant share in the agricultural waste. In particular, in 2014 emission volumes due to enteric (intestinal) fermentation amounted to 34716.2 tons (572 enterprises), cleaning, storage and use of manure, and also organic substances amounted to 28003.1 tons (573 enterprises) [5; 10].

The generation of large amounts of manure or litter is one of the challenging environmental problems of the industrial farms. The analysis of waste generation in Ukraine by categories of materials, related to agricultural activities and production, allows to make a conclusion about the high share of animal excrements, urine and manure among the wastes of I-III grade of danger, which ranges over the past five years from 9.2% in 2010 to 17% in 2014 [5; 10].

There are still no strict requirements in Ukraine on how the farm should utilize waste. The study of waste utilization by categories of materials shows insufficient volumes of utilization compared to waste generation. For example, in 2014 in Ukraine phytogenous waste was generated in the amount of 9061.4 thousand tons, and 3020.4 thousand tons of them were utilized; animal excrements, urine and manure were generated in the amount of 4037.2 thousand tons, and 3082.0 thousand tons of them were utilized [10]. The volume of waste burning is insignificant. In particular, in 2014 phytogenous waste was burned in the amount of 396.9 thousand tons (including 370.8 thousand tons for the purpose of energy generation). The unused agricultural waste is mostly placed for organized storage.

Environmental and economic measures to reduce the negative impact of agricultural production on the environment are suggested in table 2.

Conclusions. Since almost all processes associated with agricultural production (plowing, planting, tillage, harvesting and processing of products, use of fertilizers and pesticides, fattening animals), lead to environmental changes, in modern conditions agriculture is one of the key environmentally harmful activities.

An important direction in solving problems of environmental pollution is the development of ecological agriculture, based on organic farming, which is an alternative to intensive farming, meets natural

cycles, and creates artificial ecosystems to a maximum extent alike natural ones, as well as on organic livestock breeding.

To reduce the negative impact of agricultural production on the environment, the state should use the complex of environmental and economic measures, encourage dissemination and implementation of biotechnology, as well as technical modernization of enterprises. Given the problems with animal waste, its handling requires strict regulation, especially for industrial farms. One should not only pursue its safe disposal, but also efficiently use for the needs of the economy.

Table 2

Measures to reduce the negative impact of agricultural production on the environment

Economic measures	Environmental measures
- state financing of the program on withdrawal from economic circulation degraded, erosive dangerous and unproductive land, that stipulates compensation of the unearned revenue share by the owners of agricultural land; - financing of afforestation of areas; - financing of reclamation works and drainage systems functioning; - tax preferences for companies that take measures on improvement and protection of land at their own expense; - financing of research in ecosafety land use; - promotion of environmental funds activity; - exemption for land users and land owners from paying for the land, on which works on its conditions improvement is conducted; - providing tax and credit incentives to individuals who take measures to protect land and improve soil fertility at their own expense; - implementation in practice of land insurance from reducing their quality due to force majeure; - implementation of sanctions for inefficient land use; - changes in the organization of economic activities that meet current environmental standards; - designing, implementing and ensuring environmental innovations susceptibility	- development and improvement of the regional programs to improve soil fertility; - implementation of norms and standards of the ecosafe agricultural land use; - development of innovative scientific foundations and economic and environmental principles of establishing the effective soil protecting system of agriculture; - observance of crop rotation; - placing crops according to the agro-ecological conditions; - use of green fertilizers and methods of biological eliminating of pests; - use of cultivation technologies aimed at minimum interference, reduction of soil compaction; - improving agricultural chemicals and reducing their toxicity; - elaboration of environmentally friendly methods of chemicals usage in agriculture; - conducting targeted weed control not only directly in fields, but along roadsides, in forests and pastures; - competent use of fertilizers (mineral and organic), and pest and weed control methods; - limiting the use of synthetic agricultural chemicals; - introduction of low-waste and ecologically safe production technologies and farming systems; - modernization and upgrade of technological equipment in offices; - conducting environmental monitoring and control of land use efficiency; - improvement of technologies of manure recycling; disinfecting livestock manure using biological method

Source: systematized by the author

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