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Ecological and economic problems of fertilizers application in crop production

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Abstract

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Addressing urgent problems in the agricultural sector requires a comprehensive approach, taking into account the requirements of sustainable development and sustainable land use. The article deals with the key problems of reproduction of soil fertility, which determines the growing shortage of basic nutrients, the progression of soil erosion, acidification of land, and the processes of loss of humus stock. The peculiarities of mineral and organic fertilizer application are analyzed, on the basis of which it is determined that the trends of fertilization of agricultural lands in Ukraine are negative. The statistical data of the number of livestock population that directly affects the volumes of organic fertilizer production is demonstrated. The tendency of the latter and the balance of humus were evaluated, resulting in discovering of direct dependence.

The conformity of volumes of nutrient inputs with scientifically substantiated norms is estimated. It is substantiated that the volumes of the introduced mineral fertilizers do not correspond to the needs of intensive agriculture and do not provide the full necessity of plants in nutrition elements. The comparison of the level of mineral fertilizers usage in agriculture of Ukraine and world countries is carried out. It is determined that the domestic fertilizer system lags far behind the foreign ones.

The current state of the market of mineral fertilizers in Ukraine, characterized by a deficit of potassium and phosphorus components, high cost, a significant share of imports and insufficient volume of domestic fertilizers, is analyzed. The cost of lost nutrients is calculated, considering chronic shortage of nutrients and mineralization of humus, which exceeds half of product sale income. Key problems of the modern system of fertilizers usage in crop production are consolidated and conceptual directions for their solution are proposed.

Keywords: soil; humus; fertilizer; mineral fertilizers; organic fertilizers; rational land use; yield

Introduction

The agricultural sector is one of the most important in the Ukrainian economy, which can be proved by numerous indicators. (Kirieieva E. A., 2019). Ukraine has identified development of its agriculture as a strategic goal (Zulauf et al, 2018). The priority of agricultural policy should be considered to ensure environmental and economic efficiency in the context of balancing the system of use of fertilizers and the development of scientific recommendations for the optimization of nutrition in accordance with European standards.

Among the main problems that accompany modern agricultural production are the following: irrational land use; high plowing of farmland; non-compliance with the requirements of contour-reclamation organization of the territory and crop rotation; lack of adequate state support for measures aimed at improving the agrochemical and ecological status of soils, deterioration of agrophysical and agrochemical properties. All this causes a decrease in the potential yields and gross

yields of crops. The scientifically sound application of organic and mineral fertilizers is a necessary prerequisite for further improving the efficiency of agricultural production. Therefore, an urgent task for scientific research is to analyze the current state of nutrient input and justify the prospects for the latest technologies in agriculture.

The purpose of the article is to study current features in the production, supply and use of mineral and organic fertilizers in Ukraine (1); to highlight the main environmental and economic problems in fertilizer application (2); to propose conceptual directions for the solution of ecological and economic problems of fertilizers application (3).

Leading scientists are actively discussing the set of problems that accompany modern agricultural production. Mazur et al. (2014) focuses on the paradoxical situation when Ukraine, having a number of competitive advantages in the development of the agricultural sector (favorable climatic conditions, inexpensive labor and raw materials, convenient location to global sales markets), does not receive from this proper "dividends". Tokarchuk D.M. et al (2020) emphasys that unprocessed manure can create harmful emissions into the environment. At the same time agricultural waste might create social, economic and environmental effects (Pryshliak N. and D. Tokarchuk, 2020).

Pimentel et al. (2005) emphasizes on the benefits of organic technologies that have higher soil organic matter and nitrogen, lower fossil energy inputs, yields similar to those of conventional systems, and conservation of soil moisture and water resources (especially advantageous under drought conditions)

The problem of reproduction of soil fertility in Ukraine is exacerbated as there is an increasing shortage of basic nutrients of plants, the development of erosion processes, increasing the acidity of soils, that is, the processes of soil loss of humus stocks are progressing. Kaletnik & Goncharuk (2016) also emphasise on this issue, noting that "the suspension of degradation processes in the soils of Ukraine and increasing their effective fertility is the most important issue of our time". Also, Kaletnik G. et al (2019) point that current policies should address issues including environmentally friendly technologies and encourage more efficient energy use.

Khodakivska et al. (2017) are focusing attension on the escalation of nutrient loss (NPK) problems, which, according to the results of its research, have exceeded 100 kg/ha in the last ten years, with areas of acidic, saline and eroded land growing, leading to losses of about 500 million tons of soil annually. Erosion destroys up to 11 million tonnes of humus, 0.5 million tonnes of nitrogen, 0.4 million tonnes of phosphorus and 0.7 million tonnes of potassium. The annual growth of eroded lands reaches 80-90 thousand hectares.

Shuqin & Fang (2018) identify problems and challenges and suggest that zero growth of chemical fertilizer and pesticide use can be achieved by undertaking basic research on the factors that shape the use of farm chemicals, making improvements to the monitoring and statistical system for chemical fertilizer and pesticide use, setting up demonstration projects and enhancing policies formulated to reduce chemical fertilizer and pesticide use. Bowles et al. (2018) propose a set of multi-scale principles to guide research and policy for decreasing nitrogen losses in the future, and describe the economic factors that could constrain or enable their implementation.

Shah & Wu (2019) note that intensive agricultural production without adherence to ecological sustainability has led to declining soil health, land degradation, and severe environmental problems. Autors emphasize that future efforts to feed the growing population should aim for greater agricultural production within sustainable environments. In this regard, innovative steps are needed, as business-as-usual policies lack the potential to cope with these challenges. Von Cossel et al. (2019) introduce the concept of marginal agricultural land low-input systems for industrial crop cultivation. They identified the climatic and geophysical constraints on biomass production and the ability of 19 industrial crops to cope with these limitations.

However, the ecological and economic problems of fertilizers application in crop production in Ukraine need futher investigation.

Materials and Methods

The theoretical and methodological basis of the study is the dialectical method of economic processes analysis and the main provisions of economic theory on the problem of the study. To achieve the purpose of the study, a monographic method was applied – in studying the activities of agrochemical service enterprises; graphic and statistical – in the analysis of the current state of application of mineral and organic fertilizers; abstract-logical – in the formation of initial principles and conclusions, generalization and critical analysis of the results of studies of the functioning of the domestic market of mineral and organic fertilizers. The information base of the research is the statistics of the State Statistics Committee of Ukraine, scientific publications and development of domestic and foreign scientists on the problems of the efficiency of application of mineral and organic fertilizers in the territory of Ukraine, the current state of the domestic market of chemicals and agrochemical maintenance of agro-industrial complex.

Results

It is well known that agriculture has a significant contribution to the development of the domestic economy. Therefore, the growth of domestic GDP is directly related to the improvement of modern systems of agriculture, reproduction and increase of soil fertility and rational use of bioclimatic potential (Figure 1).

Fertilizing trends on agricultural land in Ukraine are negative. It is worth noting that in 1990-2017, the area of agricultural land increased by 2.4% and amounted to 41.5 million hectares in 2017. Mineral fertilizer application volumes for this period decreased by 54%, which amounted to 48.9 kg/ha in 2017, whereas in 1990 this indicator was at the level of 105.1 kg/ha. Less mineral fertilizers were introduced in 2000, which amounted to 6.7 kg/ha and 11.2% of the fertilized area. It should be noted that the agricultural area fertilized with chemical fertilizers over the study period was reduced by almost half (Table 1).

One of the important measures of reproduction and increase of soil fertility is the introduction of organic fertilizers, thanks to which 35-40% of nutrients enter the soil. In order to ensure a deficient humus balance. 340 million tonnes of organic fertilizers are needed each year (including 16 tonnes/ha in Polissia. 8 tonnes/ha in the forest-steppe), whereas in 2017 only 9.2 million tonnes were introduced. That is only 2.7% of the needed amount. The share of agricultural land fertilized with organic fertilizers in 2017 was 1.2%, compared to 13.1% in 1990.

A 96% decrease in the volume of organic fertilizers per 1 ha is caused by organic deficiency due to the negative rate of change in livestock in Ukraine. As of May 1, 2019, the number of cattle in Ukraine amounted to 3.7 million heads. which is twice less than in 1990 (8.5 million heads). Due to this. there is a significant shortage of organic fertilizers in agriculture. which leads to intensive dehumidification and deterioration of the agrophysical properties of soils (Figure 2).

Statistical evaluation of the results of the various rounds of the agrochemical survey showed that the average weighted humus content in Vinnitsa region soils was 2.62% as of 2017 and is characterized by a negative dynamics with respect to other land quality indicators.

According to researches of scientists of Vinnytsia National Agrarian University on the territory of both Vinnitsa region and all Ukraine. the negative balance of humus in soils. which is most significant in the areas of intensive agriculture. is established. As a result of degenerative soil processes. scientists estimate annual humus losses in Polissia – 1.42 t/ha in the

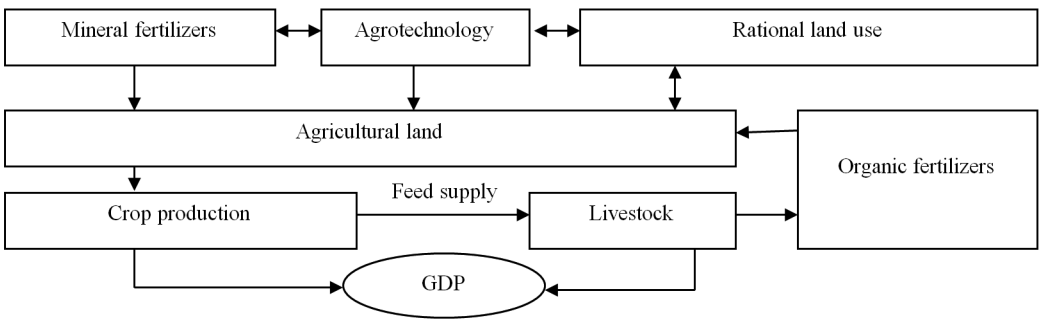


Fig. 1. Scheme for ensuring rational land use *Source:* **composed by the authors**

Table 1. Fertilizer trends in agricultural land in Ukraine

Indicator	Years							2017 till 1990 ±
	1990	1995	2000	2005	2010	2015	2017	
Area of agricultural land, million hectares	40.2	41.8	41.8	41.8	41.6	41.5	41.5	1.3
Fertilizers total, thousand tons	4414.2	529.9	281.9	560.5	1064.2	1415	2028	-2386.2
Including per 1 ha of agricultural land Land, kg	105.1	12.7	6.7	13.4	25.6	34.1	48.9	-56.2
The share of fertilized area,%	62.9	19.6	11.2	18.7	30.5	34.9	39.8	-23.1
Organic fertilizers input. millions tons	260.7	81.2	28.9	13.8	9.9	9.6	9.2	-251.5
Including per 1 ha of agricultural land, t	6.2	1.9	0.7	0.3	0.2	0.2	0.2	-6
The share of fertilized area, %	13.1	4.5	1.7	1.2	1.0	1.0	1.2	-11.9

Source: compiled by the authors based on the data from official website of the State Statistics Service of Ukraine

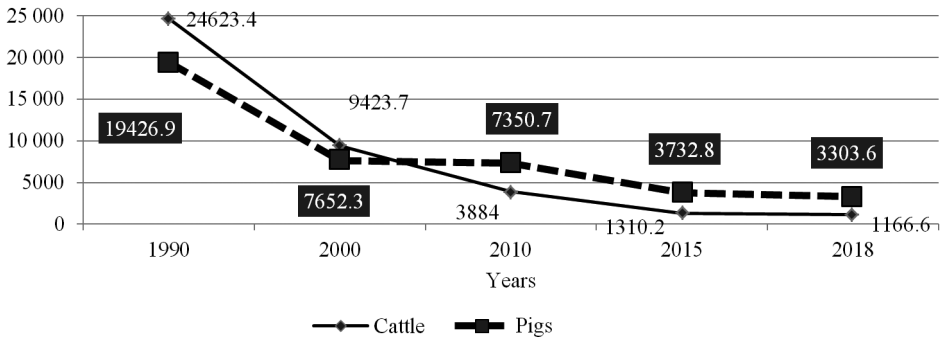


Fig. 2. Dynamics of changes in the number of animals in Ukraine over the period 1990–2018
Source: compiled by the authors based on the data from official website of the State Statistics Service of Ukraine

Forest-Steppe – 1.81 in the Steppe – 0.92 and in Ukraine as a whole – 1.08 t of humus per hectare. The key cause of land degradation is the insufficient amount of fertilizer application, the reduction of which is comparable with the negative dynamics of the weighted average humus content (Figure 3).

Analyzing the structure of applied mineral fertilizers per 1 ha, it should be noted that it differs significantly in dynamics and does not meet the scientifically substantiated norms of NPK application (1.0:0.8:0.7). In particular, in 1990, when mineral fertilizers per hectare of arable land were 105.1 kg/d, the NPK share was N – 44.2%, P_2O_5 – 31.4%, K_2O – 29.5% (1: 0.7: 0.6), that is, almost in a rational ratio. However, in 2017, the NPK structure was substantially unbalanced, accounting for N 32.9%, P_2O_5 – 8.8%, K_2O – 7.2% (1: 0.2: 0.2). Based on the above data, it can be stated that the volumes of applied mineral fertilizers do not meet the needs of intensive agriculture and do not meet the full need of plants for the nutrients, Such a structure of fertilizers has a negative impact on soil fertility, as plants receive deficient nutrients as a result of humus mineralization, the balance of which has decreased from 3.36 in 1990 to 3.17 in 2017, respectively. The predominant and unjustified application of nitrogen fertilizers (ammonium nitrate) leads to acidification of soils and the so-called "nitrate problem", that is, excessive accumulation of nitrates in grown products,

According to the UN FAO, the actual level of mineral fertilizers in Ukraine is much lower (49 kg of active ingredient) in comparison with other countries, In particular, in the Netherlands, the amount of fertilizer applied is 5.2 times higher, which is 258 kg of mineral fertilizers per active sub-

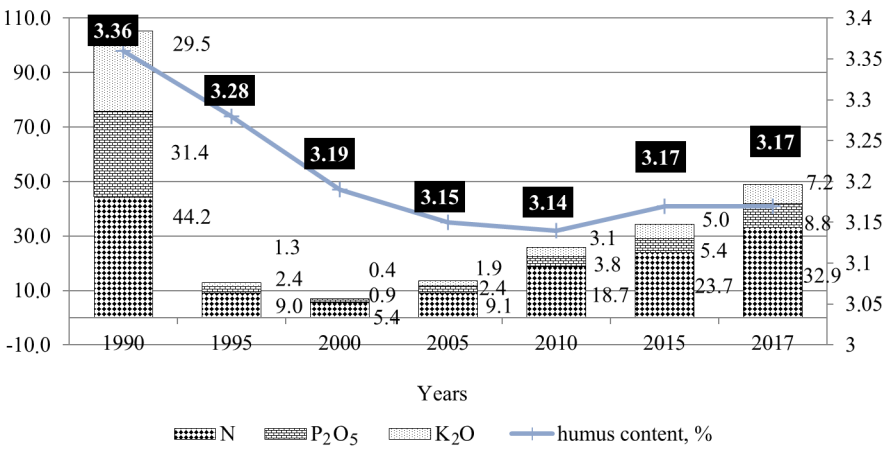


Fig. 3. Structure of mineral fertilizers introduced and humus balance in Ukraine for the period 1990–2017, kg of active substance per 1 ha
Source: compiled by the authors based on the data from official website of the State Statistics Service of Ukraine. State Institution "Institute for Soil Conservation"

stance per 1 ha of agricultural land, on average, while in the UK – 247 kg, Israel – 240 kg, Germany – 202 kg, Belarus – 194 kg, Poland – 176 kg, France – 169 kg, Czech Republic – 153 kg, in the USA – 137 kg, Italy – 129 kg, Hungary – 118 kg, Turkey – 107 kg (Figure 4).

Considering the fact that the current level of use of mineral fertilizers in agriculture not only significantly lags behind that of the developed agricultural countries of the world, but also does not provide simple compliance with the balance of nutrients in the agricultural sector, we can expect its further increase as an important strategic factor in maintaining the competitiveness of the industry. In many respects, this depends on the possibilities of preserving and increasing the capacities of the domestic chemical industry.

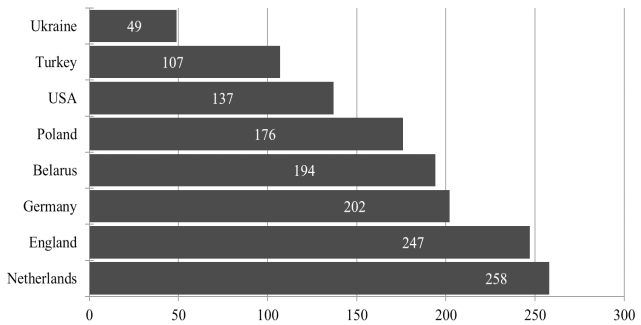


Fig. 4. Fertilizer application to world countries compared to Ukraine, kg of active substance per hectare

Source: compiled by the authors based on the data from official website of the State Institution "Institute for Soil Conservation"

During 2017–2018, the geography of the import of mineral fertilizers into Ukraine has significantly changed. In particular, there have been significant changes in the volume of imports of various types of mineral fertilizers from the Russian Federation. According to the Decree of the Cabinet of Ministers of Ukraine №1147 dated 12/12/2015 and № 1022 dated 12/20/2017, measures of state protectionism were applied due to the ban on the import from the Russian Federation to Ukraine of a number of plant protection products, mineral fertilizers and their components.

As of October 2018, due to a drop in imports, the supply of nitrogen fertilizers decreased by 33% and amounted to 2867 thousand tons, which is 11% less than the same period last year. Import of potash and phosphorus fertilizers also fell by 35%, which as a result affected the final balance of this group of fertilizers, since domestic production almost did not produce fertilizers of this group. The security as of October 2018 amounted to 953 thousand tons, which is 35% less than last year.

In general, in 2018 we observe a market decline of 20% in providing all fertilizers compared to 2017. In 2017, 64.9% of imports accounted for the Russian Federation, then in 2018, the import of fertilizers into Ukraine was distributed between six importing countries, where the share of Russia decreased by more than three times (19.5%) (Figure 5). This has accordingly affected the volume of imports, which tends to decrease. Phosphorus fertilizers from Serbia and Egypt began to be supplied to Ukraine, and the volumes of supplies from Belarus also increased.

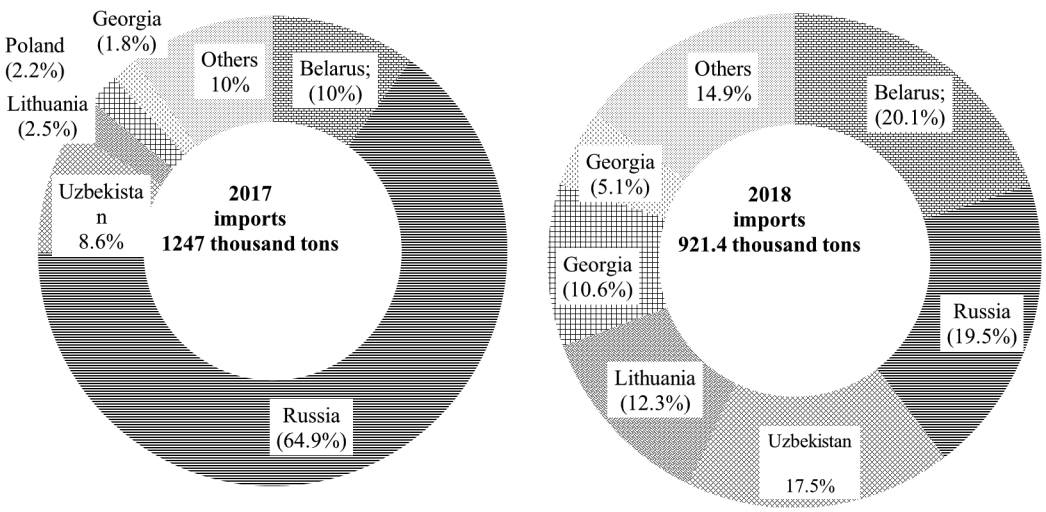
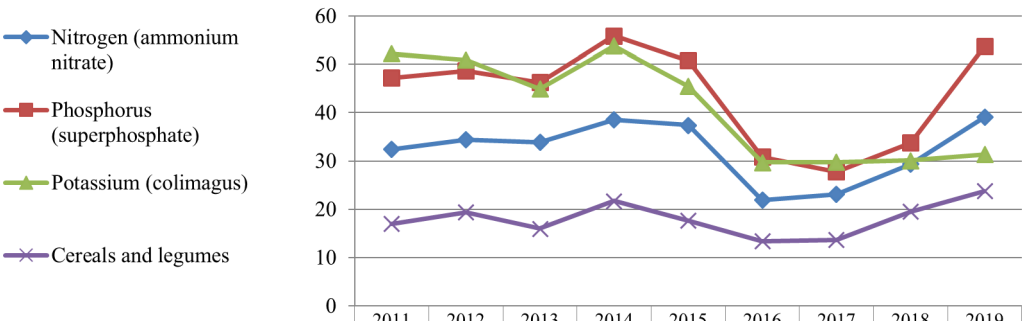


Fig. 5. Import of nitrogen fertilizers to Ukraine

Source: compiled by the authors based on the data from official website of the State Statistics Service of Ukraine



	2011	2012	2013	2014	2015	2016	2017	2018	2019
Nitrogen (ammonium nitrate)	32,4	34,4	33,9	38,5	37,4	21,9	23,1	29,4	39,1
Phosphorus (superphosphate)	47,2	48,6	46,3	55,9	50,8	30,8	27,8	33,7	53,7
Potassium (colimagus)	52,2	50,9	44,9	53,8	45,4	29,7	29,8	30,1	31,3
Cereals and legumes	17	19,4	16	21,7	17,6	13,4	13,7	19,5	23,8

Fig. 6. Purchase prices for mineral fertilizers, USD / 100 kg

Source: compiled by the authors based on the data from official website of the State Statistics Service of Ukraine

The high growth rate of the cost of mineral fertilizers prevents the expansion of their use. The limited supply of fertilizers from the Russian Federation led to a certain deficit in the potash and phosphorus fertilizers market, which, according to our estimates, is about 50%. This can be considered one of the reasons for their rise in price (Figure 6), which helped to deepen the disparity in prices for agricultural and industrial products, and as a result, led to a decrease in the volume of fertilizers.

The low level of fertilizer use is also associated with a high proportion of other components of the cost of agricultural products: high credit rates, volatility of the national currency and the dependence of agricultural prices on the situation on world markets. Thus, for the period from 2011 to 2019, nitrogen fertilizers went up 4.9 times, phosphorous – 3.96, potassium – 2.08 times. The value of cereals and legumes has increased almost three times over the studied period, but the price ratio of mineral fertilizers and cereals is on average 1: 2, which automatically leads to "leaching" of funds from agrarians. The price disparity can be considered in Table 2.

It is noteworthy that in order to purchase ammonium nitrate in 1990, it was necessary to allocate 1.1 tons of wheat crop, and superphosphate – 900 kg. In 2019, it was necessary to allocate 2.3 tons and 3.2 tons, respectively. This indicates a more progressive growth rate of prices for fertilizers than for grain, respectively, and an increase in their parts among the components of cost.

Having a significant potential for the export of crop production, as a result of non-compliance by business entities with an agricultural culture, we actually "irrevocably" export "nutrients". We illustrate this trend by the example of the calculations (Table 3).

According to the table, it can be noted that the increase in yield is accompanied by an increase in the imbalance between the volume of NPK application and their removal by plants, So, for example, corn in 1990 with a yield of 3.87 tons per hectare and the application of NPK in a ratio of 1: 0.5: 0.5 kg of active ingredient per hectare, the imbalance was -25: -38: -178 kg of active substance per hectare respectively; in 2017, with a yield level of 78.4 kg/ha and NPK application in a ratio of 1: 0.3: 0.2, the imbalance was -111: -149: -425. That is,

Table 2. Agricultural price disparity

Indicator	Year					
	1990	2000	2005	2010	2015	2019
The average price of wheat (2 class) USD/ton	67.3	105.7	77.4	171.8	144.0	170.8
Need for the sale of grain (ton) for purchase:						
1 ton diesel fuel	0.2	14	16.75	6	7.2	7.4
1 ton gasoline	0.7	9.6	11.5	8.2	8.3	7.7
1 ton ammonium nitrate	1.1	2.5	3.2	1.9	2.6	2.3
1 ton superphosphate	0.9	1.7	2.2	2.8	3.5	3.2

Source: compiled by the authors based on the data from official website of the State Statistics Service of Ukraine

Table 3. The effect of yield and fertilizer application on nutrient balance for the period 1990-2017

Years	Wheat										Maize									
	Yield, kg/ ha	Removal of nutrients, kg of active substance / ha			The input of nutrients, kg/ha			Nutrient balance, kg/ha			Yield, kg/ha	Removal of nutrients, kg of active substance / ha			The input of nutrients, kg/ha			Nutrient balance, kg/ha		
		N	P	K	N	P	K	N	P	K		N	P	K	N	P	K	N	P	K
1990	40.2	121	121	314	60	32	30	-61	-89	-284	38.7	93	84	217	68	46	39	-25	-38	-178
2000	19.8	59	59	154	13	2	1	-46	-57	-153	30.1	72	65	169	15	3	1	-57	-62	-168
2010	26.8	80	80	209	45	6	5	-35	-74	-204	45.1	108	97	253	53	10	8	-55	-87	-245
2015	38.8	116	116	303	52	8.6	7	-64	-107	-296	57.1	137	123	321	63	11	11	-74	-112	-310
2017	37.3	112	112	291	66	14	11	-46	-98	-280	78.4	188	169	440	77	20	15	-111	-149	-425

Source: compiled by the authors based on the data from official website of the State Statistics Service of Ukraine

when growing corn for grain, the NPK removal was 7 times higher than their income, for wheat growing – 5.7 times.

According to the estimates of scientists, the cost of the main components of soil fertility is: 1 kg of humus – 96.1 USD, 1 kg of nitrogen – 1.03 USD, 1 kg of phosphorus – 1.39 USD, 1 kg of potassium – 0.64 USD. Thus, in 2017, with a gross corn harvest of 24.67 million tonnes and 26.16 million tonnes of wheat, considering the shortage of nutrients, Ukraine lost NPK of USD 6.17 billion, which is about 78% of its export earnings (Table 4). As land economists are positioned as the main means of agricultural production, these nutrient losses should be characterized as depreciation of land resources, which leads to a deterioration of its agrochemical properties and production potential as a whole. At the legislative level, no provision is made for recording these costs and taking them into account in the cost of production, which does not allow proper control over the proper financing of soil regeneration measures.

According to the table, we note that net export revenue, taking into account the cost of lost nutrients in 2017, is virtually absent for winter wheat, and for corn - three times less than actual, We see the problem of low profitability in that domestic exporters sell in most cases raw materials with low added value, Based on our studies, we consolidate key problems in the use of mineral and organic fertilizers and offer conceptual directions for their solution (Table 5).

Table 4. Economic losses caused in 2017, billion USD

Culture	Cost of nutrients lost, billion USD				Gross collection, thousand tons	Cost products, billion USD	Export, thousand tons	Export receipts, billion USD	Export revenue based on nutrients lost
	N	P	K	Total					
Corn	0.51	0.93	1.22	2.66	24668.8	3.79	18151.4	3.84	1.18
Wheat	1.17	1.11	1.23	3.51	26158.0	4.11	15274.6	3.55	0.04
Total	1.68	2.04	2.45	6.17	50826.8	7.90	33426.0	7.39	1.22

Source: calculated by the authors based on the data from official website of the State Statistics Service of Ukraine

Table 5. Conceptual directions for solving environmental and economic problems of the use of mineral and organic fertilizers in crop production

Problem	Conceptual solution
Failure to comply with agricultural activities, low level and imbalance in the fertilizer application	Strengthening of state control, establishment of regional offices of State Institution «Soil Conservation Institute»; Scientific Advice Centers for the Development of Complex Fertilizer Systems,
The high cost of fertilizers and its significant share in the cost	State support for the development of the domestic fertilizers market, reduction of imports
Organic deficiency and negative humus balance	Measures to encourage livestock development (obligation to maintain the established rate of head of animals per unit of arable land)
Disregarding damage caused by crop cultivation due to destructive processes in soils	Strengthening of the control over the exploitation of the lands according to their purpose and scientifically grounded agrotechnics
The dominance of the raw material component in the commodity structure of exports,	Diversification of production due to deepening of processing of products and taking into account natural and climatic conditions that will maximize value added

Source: Composed by the authors on the basis of Berezyuk S. et al, 2019 and Pryshliak N., 2019

Solving consolidated problems requires the systematization of certain institutional measures. The determining factor is the tightening of control over observance of elementary links of crop rotation, the creation of tinned territories, and the preservation of field forest stands.

One of the ways to reduce the cost of using mineral fertilizers should be the use of liquid forms of nitrogen fertilizers; in particular ammonia water and urea-ammonia mixtures, the effectiveness of which has been confirmed by the practice of developed countries, for example, in the USA up to 50% of nitrogen fertilizers are used in liquid form.

Given the insolvent demand for mineral fertilizers and organic deficiency, we support the opinion of scientists about the need to till crop-root residues and green manure crops. This will provide the necessary balance of organic matter, as 1 ton of straw forms about 0.2 tons of humus, and for 2 years of growing perennial grasses, 4-5 tons of root and post-cut residues remain in the soil equivalent to a single application of 15 t/ha of manure.

Conclusions

According to the results of the conducted research, it should be noted that the growth of domestic GDP is directly related to the improvement of modern systems of agriculture, reproduction and increase of soil fertility and rational use of bioclimatic potential. The domestic agro-sector is characterized by an increasing shortage of basic nutrients of plants, the development of erosion processes, increasing the acidity of soils, that is, progressing processes of soil loss of humus reserves. We consider these problems as a derivative of reducing the volume of organic, mineral fertilizers, non-observance of scientifically justified crop rotations, ignoring the law of returning the basic nutrients to the soil, etc. These arguments are confirmed by analytical results that show a decrease in organic fertilizers by 96% relative to 1990. Organic deficiency is due, first of all, to the negative rate of change in the livestock population.

The analysis of the structure of the introduced mineral fertilizers made it possible to reveal a significant inconsistency with the scientifically grounded application standards due to the shift towards nitrogen-containing substances. This trend does not meet the conditions of intensive agriculture and does not provide the full needs of plants in the nutrients, which, accordingly, adversely affects the fertility of the soil, as plants receive deficient nutrients as a result of the mineralization of humus.

A comparison of the dynamics of fertilizers by Ukrainian farms with foreign practice demonstrates significantly reduced nutrient input in our country relative to global farmers, and determines the decline in the competitiveness of domestic agricultural products on world markets. Reasons for lack of batteries in the domestic farming practices seen in the high cost of fertilizers, as a consequence of a significant share of imports in the structure and the lack of domestic production. Particularly acute is the increase in the disparity in prices for agricultural products and their cost components.

An analysis of yield trends showed an increasing imbalance between the volume of NPK introduction and the removal of their plants. It has been calculated that when corn is grown for grain, NPK yields are 7 times higher than their incomes, and 5.7 times for wheat cultivation. Based on the calculations, it was proved that due to the shortage of nutrients while growing only two of the studied crops - corn and wheat, the state lost NPK reserves in the amount of 6.17 billion USD, which is about 78% of the export earnings for these crops.

It is proposed to solve the identified problems by strengthening state control through the establishment of regional representative offices and scientific consulting centers on the development of complex fertilizer systems, intensification of state support for the production of domestic fertilizers and reduction of their import, introduction of measures to stimulate the development of animal husbandry, strengthening the control of their operations in accordance with the operations purpose and science-based agrotechnics, diversification of production due to deepening product processing and consideration of climatic conditions.

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