

UDC (631.17: 633.1): 631.452

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Ecological and economic assessment of growing cereal crops in a context of restoration of fertility of soils

Goal. Test methodological approaches to the monetary assessment of the deterioration of soil fertility due to the loss of nutrients. **Methods.** Balance and expense. **Results** Ecological and economic losses for the cultivation of grain crops are estimated at 375-2355 UAH / ha depending on the intensity of the fertilizer system. The positive effect of straw stacking was 27 - 547 UAH / ha. **Conclusions** The results of the research can be used to substantiate the economic mechanism of reproduction of soil fertility.

Key words: humus balance, loss of nutrients, soil depletion, ecological and economic damage.

Losses of nutrients due to erosion in Ukraine each year make: ammonium sulphate - 629 thousand tons, superphosphate - 290 thousand tons and potassium salt - 210 thousand tons. This amount of fat is enough to produce 875 thousand tons of grain [3]. In intensive crop production, the preservation and improvement of soil fertility is the provision of a nutrient-rich balance of nutrients. Therefore, the problem of monetary assessment of the loss of macro-materials for the cultivation of crops and the determination of the cost of agro-technology measures aimed at restoring the mineral balance due to this activity remains relevant.

Analysis of recent research and publications. To save resources and increase the effectiveness of environmental safety P.V. Tarkhov and O.O. Ill suggests to develop a mechanism of environmental liability, compensation to land users for the deteriorated state of land. The authors improve the way of the expert estimation of agricultural land using multi-choice choice based on the analysis of the indices of the conditional reference plot proposed by the scientists of Lviv State Agrarian University, in particular O.F. Kovalishin, due to an increase in the analysis of the influence of factors of fertility [6]. Methodology for estimating losses due to deterioration of soil conditions was substantiated by A.V. Skrypnyk and I.S. Mikhno [5], and from the deterioration of soil fertility - scientists NSC "Institute of Soil Science and Agrochemistry O.N. Sokolovsky »M.M. Miroshnichenko, K. B. Smirnov, A.O. Khristenko et al. [2]. In international practice, estimating financial losses from soil depletion due to the loss of nutrients is relevant for many countries [10, 11].

Materials and methods of research. The article analyzes intensive, resource-saving and adaptive technologies of growing winter wheat, spring barley and corn on grain based on basic technological maps developed by specialists and specialists of KhNAU them V.V. Dokuchaev [7]. The level of ground clearance is determined depending on the intensity of the technologies. In assessing the size of the ecological and economic damage caused by the deterioration of soil fertility, various types of grain production technologies used a balance-sheet, as well as a cost-effective approach based on determining the market value of the cost of reproduction of fertility (agronomic quality) of soils.

Research results. The economic loss is understood as the actual and potential losses incurred as a result of the environmental degradation and the additional costs incurred in compensating for these losses in value form. Environmental damage is considered as actual and possible losses in their quantitative and qualitative terms, in particular, additional costs for the treatment of adverse consequences resulting from adverse effects of economic and other activities, man-made accidents and disasters. The concept of ecological and economic damage, which is most commonly used in the economy, is understood as a monetary assessment of the negative impact of business and other activities on the population, agricultural land, forest resources, etc. In the field of agriculture, the ecological-economic loss indicator as an indicator of economic evaluation involves the assessment of possible and actual losses in cash, in particular, soil fertility, and soil depletion, and the role of the economic criterion of environmental measures can be used to

prevent damage [9]. In the case of growing crops - the cost of nutrients necessary to return at least a deficit-free balance of micro-elements in the soil.

A negative balance of humus and nutrients is indicative of a decline in soil fertility in Ukraine. In the period of intense chemicalization (1976-1990), the balance of nutrients was on average 20-30 kg / ha more than equilibrium. Since the beginning of the 90s of the last century, a negative balance of all nutritional elements has been recorded annually for a special deficit of nitrogen and potassium.

In view of the above, the task was set: to determine the efficiency of cereal cultivation techniques, to observe how the intensity of technologies affects the balance in soils of nitrogen, phosphorus and potassium, and to assess ecological and economic losses depending on the fertilizer system.

The evaluation of the technologies was carried out in 3 directions (economic, energy and ecological efficiency) on the basis of 5 criteria, namely: the cost per hectare, the receipt of the necessary profit per 1 hectare, the coefficient of energy efficiency, the determination of the coefficient environmental friendliness and return ratio of nutrients.

The economic and energy assessment of technologies, highlighted in previous works by the author [8], has shown that the most effective were intensive technologies.

The determination of the environmental assessment of the efficiency of the technologies was based on the return of the nutrients or the intensity of the balance (I_b), which shows how many percent of the extraction of the nutrient element is ensured by the crop through fertilization. On this basis, it is possible to distinguish, respectively, the enrichment ($I_b > 100\%$), depleting ($I_b < 100\%$) and balanced or neutral ($I_b = 100\%$) technologies.

According to the return factor of nutrients, all technologies require adjustment of the fertilizer system (Table 1). The amount of mineral fertilizers does not restore the balance of nutrients. This may in the future lead to deterioration of soil fertility. Worst of all, the restoration of the balance of nutrients in the soil is observed during the cultivation of grain crops by adaptive technologies. These technologies are debilitating.

Determination of ecological and economic losses on the basis of the balance of nitrogen, phosphorus and potassium (at prices in 2013) for the cultivation of grain crops

According to the soil scientist, in the future, degraded soil will require much higher costs for reproduction of fertility, so even an approximate estimate of the amount of damages and funds for the restoration of degraded land is important given the need to bear responsibility for the consequences of exhausting agriculture on business entities today.

The analysis of losses during cultivating agricultural crops based on the indicator of the intensity of the balance enables to reduce possible losses for the use of specific technology at the time of the development of the fertilizer system, to pre-evaluate the ecological and economic losses of soil fertility and to decide on adjusting applied technology or determining the amount of compensation for future losses.

The determination of ecological and economic losses from the loss of nutrients based on the market value of fertilizers has the following algorithm:

1. Determine the balance of nutrients in the soil on a specific technology, as the difference between the amount of nutrients that hit the soil with fertilizers and cultivars.
2. Determine how much nitrogen, phosphorus and potassium fertilizers can compensate for the difference in substances in the balance (for negative balance) or corresponds to the difference (for the positive balance).
3. On the basis of the market value of fertilizers, we find the value of fertilizers, which can compensate for the difference in substances in the balance (for negative balance) or corresponds to the difference (for the positive balance).

The results of conversion of the indicators of ecological efficiency into the value of the investigated technologies of growing of cereals are presented in Table. 1.

If we take into account the ecological and economic damage of the values of the yields of phosphorus and potassium, as suggested by some agrochemists, then the results change radically.

The absence of nitrogen in the calculations is explained by the fact that its amount in the soil varies greatly depending on the conditions (weather, crop rotation, fertilization, soil cultivation), therefore, the balance calculation of the required nitrogen is not precise for determining ecological damage or deterioration of soil fertility.

In addition, practically all nitrogen in soils (up to 90 - 95%) is composed of humus and other organic compounds, that is, in a slightly soluble and inaccessible form of plants. There is a direct correlation between the content of total nitrogen and humus in soils, but there is practically no link between the total content of nutrients in the soil and the effectiveness of fertilizers.

At the same time, the presence of nitrogen in the soil is one of the most important indicators of its fertility, and, as a rule, in the unfertilized arable land, plants lack the nitrogen contained in the soil in a mineral form. That is why nitrogen fertilizers are required to produce high crop yields. That is, nitrogen can be considered as a necessary element for increasing crop yields, and not as a criterion for determining the quality of the soil.

The economic assessment of the environmental damage to the cost of fertilizers that compensates for lost elements has decreased by the value of nitrogen fertilizers by an average of 43.5% of the cost in the first variant for winter wheat, and by 56.7% - for spring barley.

The value of the energy assessment of environmental damage decreased by 86% for winter wheat and 92% for spring barley compared to the first variant of the study. This difference can be explained by the irreparable difference between the energy price of nitrogen fertilizers and their market value. The study showed that 1 kg of nitrogen fertilizers is the most expensive energy estimator and the least expensive. Of course, since this imbalance can not be corrected in the near future, then the second option for estimating environmental and economic losses will not be objective and its application will not allow determining the level of damage caused to the ground.

In our opinion, it is more appropriate to assess the environmental and economic damage during the cultivation of crops taking into account both nitrogen and phosphorus and potassium. In particular, to increase yields, it is necessary to return nitrogen and potassium not less than 80%, and phosphorus - 100% and more.

In our study, we focused on losses caused by the soil due to loss of humus (Table 2).

Determination of ecological and economic losses on different technologies of growing of grain crops on the basis of balance of humus, phosphorus and potassium (at 2013 prices).

The calculations have shown that the cost of damage to the soil due to the loss of nutrients may be somewhat offset in value terms due to the positive the balance of humus, but if the straw is stacked. Otherwise, the value of environmental damage, for example, when winter wheat is grown under adaptive technology, due to a shortage of humus and nutrients is 1054.2 UAH / ha.

The calculations of other scientists have shown that the cost of damage caused by the soil due to humus losses is almost 40 times higher than the annual economic loss from underperformance crop production [4]. However, these losses are usually not considered in economic activity. Therefore, the search for ways to introduce a mechanism for the enumeration of environmental damage from losses of humus and nutrients to production costs can become an effective factor in the conservation and reproduction of soil fertility, the basis for determining the monetary valuation of land, which is the basis of an efficient tax system.

Conclusions

The need for fertilization is proved by the fact that the soil is capable of gradually giving the plant nutrients, and the increase in the viability of crops is directly related to mineral fertilizers. In this case, the quality of products improves, for example, nitrogen fertilizers increase the content of protein in the grain by 1 - 3%; Mineral fertilizers stabilize the content of humus in the soil, contributing to an increase (up to 30%) in the mass of sown and root residuals, which create better conditions for productive use of moisture [4].

At present, there is a need to identify ecological and economic losses not at the level of growing a separate culture or a separate economy, but using the more global methods of economic estimation of nutrient loss, for example, the method of predictive modeling of nutrient balances and the processing of various variants of the effect of soil fertility change on the country's agricultural economy.

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