METHODICAL APPROACH OF SUBSTANTIATION OF POTENTIAL INDICATORS OF LAND USE EFFICIENCY IN AGRICULTURE

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The article reveals that along with the traditional indicators of the efficiency of productive land use (the ratio between the resultsof the sale of in value or in kind products and the unit of land resources use), it is advisable to apply the indicator of the level of realization of their potential that will comprehensively reflect the achieved level of land use efficiency and possible reserves of increasing the agricultural production. Studies regarding the problems of the economic efficiency of agricultural production, including innovative developments aimed at increasing the productivity of land in the production of crop products, were carried out by many scientists, however, both in training and in real production conditions, as a rule, potential values of land use efficiency in industry are not taken into account. In this regard, studies of the methodological aspects of substantiation of the potential indicators of land productivity and the identification on this basis of the reserves for increasing the efficiency of land use become relevant. The purpose of the article is to present modern methodological tools for the economic evaluation of the efficiency of land use in agriculture. The proposed methodology for calculating potential yield indicators of the main cultivated crops was tested on the basis of the "Pobeda" collective farm in the Ceadir-Lunga district making a comparison between the actual and normative indicators of the profit per unit area. On this basis, land use efficiency reserves have been identified. The results of the research allows specialists of agricultural enterprises, as well as professors and students of higher education institutions to determine the normative indicators of land productivity and the profit volumes for each cultivated crop on the basis of simple calculations, and thus to identify reserves for improving land use efficiency.

Keywords: *land resources, profit, land use, income from sales, cost price, reserve, efficiency.*

În acest studiu se evidenţiază că, pe lângă indicatorii tradiţionali de eficienţă în utilizarea terenurilor productive (raportul dintre rezultatele realizării produselor în valoare sau în natură şi unitatea de resurse funciare utilizate), o importanţă deosebită prezintă indicatorul nivelului de realizare a potenţialului acestora, care reflectă în mod complex nivelul atins de eficienţă a utilizării terenurilor şi posibilele rezerve de creştere a producţiei agricole. Studiile privind problemele legate de eficienţa economică a producţiei agricole, inclusiv ale dezvoltări inovatoare care vizează creşterea productivităţii terenurilor în producţia produselor vegetale, au fost efectuate de mulţi oameni de ştiinţă, cu toate acestea atât în formare, cât şi în condiţii reale de producţie, de regulă, nu se iau în considerare valorile potenţiale ale eficienţei utilizării terenului în industrie. În acest sens, devin relevante studiile aspectelor metodologice de fundamentare a indicatorilor potenţiali ai productivităţii terenurilor şi identificarea, pe această bază, a rezervelor de creştere a eficienţei utilizării terenurilor. Scopul studiului este de a prezenta instrumente metodologice moderne de evaluare economică a eficienţei utilizării terenurilor în agricultură. Metodologia propusă pentru calcularea indicatorilor potenţiali ai randamentului culturilor principale cultivate a fost testată în baza fermei colective „Pobeda" din raionul Ceadîr-Lunga. S-a realizat o comparaţie între indicatorii actuali şi normativi ai profitului obţinut de pe unitate de suprafaţă; în bază acesteia au fost identificate rezervele de eficienţă a utilizării terenurilor. Rezultatele cercetării permit specialiştilor întreprinderilor agricole, precum şi profesorilor şi studenţilor instituţiilor de învăţământ superior să determine pe baza unor calcule simple indicatorii normativi ai productivităţii terenurilor, valoarea profitului pentru fiecare cultură cultivată şi rezervele de îmbunătăţire a eficienţei utilizării terenurilor.

Cuvinte-cheie: *resurse funciare, profit, utilizarea terenurilor, venituri din vânzări, costuri, rezerve, eficienţă.*

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В статье представлено, что наряду с традиционными показателями эффективности использования продуктивных земель (отношение результатов реализации продукции в стоимостном или натуральном выражении к единице используемых земельных ресурсов) целесообразно применять показатель уровня реализации их потенциала, который будет комплексно отражать достигнутый уровень эффективности использования земли и возможные резервы наращивая производства сельскохозяйственной продукции. Исследования проблем экономической эффективности сельскохозяйственного производства, в том числе инновационных разработок, направленных на увеличение продуктивности земли при производстве продукции растениеводства проводились многими учеными, однако, как в учебных, так и в реальных производственных условиях, как правило, не учитываются потенциальные значения эффективности использования земли в отрасли. В связи с этим актуальными являются исследования методических аспектов обоснования потенциальных показателей продуктивности земли и выявления на этой основе резервов роста эффективности землепользования. Цель исследования – представить современный методический инструментарий экономической оценки эффективности использования земли в сельском хозяйстве. На примере колхоза «Победа» Чадыр-Лунгского района апробирована предложенная методика расчета потенциальных показателей урожайности основных возделываемых культур и проведено сопоставление фактических и нормативных показателей выхода прибыли с единицы площади; на этой основе выявлены резервы эффективности землепользования. Результаты исследований позволят специалистам сельскохозяйственных предприятий, а также преподавателям и студентам высших учебных заведений в результате несложных расчетов определять нормативные показатели продуктивности земли и объемы поступления прибыли по каждой возделываемой культуры и на этой основе выявлять резервы повышения эффективности землепользования.

***Ключевые слова**: земельные ресурсы, прибыль, землепользование, доходы от реализации, себестоимость, резервы, эффективность.*

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CZU: 338.43

Introduction. In crop production, the high profit obtained per one hectare of land is an important condition for increasing the efficiency of operating activity, i.e. more complete use of the land efficiency potential and the biological potential of plants. The operating activity of agricultural enterprises is carried out under the influence of unpredictable fluctuations in weather conditions. In this regard, the business development option in agriculture should be considered economically independent, if it ensures an average annual profitability sufficient to maintain at least simple reproduction by preserving fluctuations in production volumes in certain years.

Along with the traditional indicators of the efficiency of productive land use (the ratio of the results of the sale of products in value or in kind to the unit of land resources used), it is advisable to apply the indicator of the level of realization of their potential that will comprehensively reflect the achieved level of land use efficiency and possible reserves of increasing the production of agricultural products.

It is known that the indicators of products obtained per unit area do not directly characterize the level of land management. The development of a mechanism of interrelation between yield and volume of profit received is quite in demand, both in theoretical and practical aspects. It is important that the mentioned mechanism can be accessible for practical application by specialists of agricultural enterprises.

Overview of recent research. Modern agricultural science is looking for new ways to improve the efficiency of agricultural production. In this sense, works of A. Shavronov present a special interest, where a new approach to the evaluation of efficiency is proposed and the justification of the factors in growth of efficiency is given [1, p.61-63]. The studies of A. Akishin are important, in which, based on the experience of the Volgograd region, the directions of the development of agriculture are substantiated taking into account the natural and climatic features of the region [2, p.60-63].

Studies of the problems of the economic efficiency of agricultural production, including innovative developments aimed at increasing the productivity of land in the production of crop products, were carried out by such scientists as M. Prisyazhnyuk, P. Sabluk, V. Mesel-Veselyak [3], V. Ambrosov [4], V. Nechaev and others. The need to ensure the livelihoods of agricultural enterprises represents the cause of transformation processes in the industry. According to V. Nechaev and other scientists [5],

the technical and technological potential of agricultural production is the maximum possible production result in the existing natural and climatic conditions that can be obtained using available resources within the framework of new technologies and forms of organization of production. Such approach will allow to evaluate objectively the efficiency of land use and to reveal real reserves of profit growth.

The questions of justification of land use policies are considered in the economic literature from different perspectives. In particular, the issues of managing the land potential as a basis for economic development of regions are considered in the works of S. Volkov, N. Komov, V. Khlystun [6] and other authors. V. Miloserdov's publications are devoted to separate aspects of the problem of effective land use, he advocated the principle of enlarging the cultivated areas in agro-enterprises [7]. A. Varlamov emphasized the importance of state regulation of land relations [8], I. Usachev, A. Yugai and V. Chernikov mentioned the importance of stimulating the rational use of agricultural land [9].

Among the Moldovan authors it is worth mentioning the works of doctors habilitat of economic sciences A. Stratan and E.Timofti, who developed and proposed their variants of the economic mechanism for increasing the efficiency of agriculture on the basis of rational land use in their studies [10, 11]. A team of authors, headed by professor T. Bajura, developed tariffs for the cost of agricultural products and services, and presented a weighted average consumption that was socially and economically justified to achieve a stable level of soil fertility [12]. Also the studies of doctors of economic sciences L. Todorich and T. Dudoglo are of great importance, they aimed respectively at studying the problems of the sustainability of agricultural production [13] and assessing the level of stability in the productivity of the regions' lands [14].

Research methodology. A system of indicators is used in the calculation of the economic efficiency of production and sale of crop production at agricultural enterprises. However, both in training and in real production conditions, as a rule, potential values of the efficiency of land use in the industry are not taken into account. In this regard, it is relevant to study methodological aspects of justifying potential indicators of land productivity and identifying reserves for increasing land use efficiency. In crop production, obtaining high yields of produced products is an important condition for ensuring high production efficiency, i.e. more full utilization of the potential of land productivity and the biological potential of plants. Thus, the main research methods used are: analysis and synthesis, induction and deduction, logical analysis. The justification of indicators of potential land use efficiency was conducted on the basis of the „Pobeda" collective farm in the Ceadir-Lunga district.

The purpose of the article is to present modern methodological tools for the economic evaluation of the efficiency of land use in agriculture, which can be used by specialists of agricultural enterprises, as well as by teachers and students of higher educational institutions.

Obtained results and discussions. Taking into account that the incomes and profits from the operating activities of agricultural enterprises of the Republic of Moldova, including the Autonomous Territorial Unit of Gagauzia (ATU Gagauzia) occupy more than 95%, it is important to investigate the sources of revenue streams from this type of activity. The studies have shown that the profit from crop production in recent years (2010-2015) has reached 91.8% of the total profit of agricultural enterprises. Therefore, highly effective use of land in agriculture is a crucial condition for the development of agriculture in the region [15, p.21].

The absolute indicators of the profit volume cannot be comparable due to the differences in size as well as the organizational and legal forms of agricultural organizations. Therefore, a relative and universal indicator of the production efficiency should be chosen, which would be universal and used in all cases. Such an indicator, reflecting the efficiency of the use of land resources, is the profit obtained per hectare of land.

In view of the foregoing, we will focus our attention on the problems of effective land use in agriculture and identify the potential level of the efficiency of land resources that will preserve economic independence and the possibility of maintaining at least simple reproduction.

Indicators of potential land efficiency can be calculated for a farm, district, region, or republic as a whole. For known reasons, it is easier to ensure a higher return on costs on a smaller area of one farm than in the whole country or region.

It should be noted that starting from 2013, National Bureau of Statistics of the Republic of Moldova does not publish data on the cost of production, thereby it is not possible to analyse the economic efficiency of production and sales of agricultural products. That is why we turn to the indicators of production and sales of products in certain economic entities. Thus we have chosen the "Pobeda" collective farm in the Ceadir-Lunga district, which has managed to maintain the production structure and the volumes of land use. In this farm, as in the whole region, the crops of wheat, corn and sunflower occupy about 4/5 of the sown

area. That is why it is important to identify the state of land use efficiency in the production of these particular crops.

To justify the indicators of the potential efficiency of land use, characterizing the profit per unit area of certain crops, it is necessary to investigate at least a nine-year period. It is proposed to use the formula:

$$E = \sqrt[3]{p_1 \cdot p_2 \cdot p_3}, \quad (1)$$

where, E – the potential indicator of the profit obtained per unit area, lei/ha;

p_1, p_2, p_3 – the highest indicators of profit per unit area over three years out of the nine, lei/ha.

Potential indicators of profit from one hectare can be considered normative for this business entity. In other words, in its operational activity every enterprise cultivates one or another agricultural crop according to the technology developed by them, which, in the long run, allows to obtain a profit volume that would not be lower than the normative one.

The methodology for determining these potential levels of land productivity was considered on the example of the collective farm "Pobeda" in the Ceadir-Lunga region for 2008-2016 (table1).

Table 1

Indicators of sales of products of leading crops in the collective farm "Pobeda" for 2008-2016

	Sales, q	Costs, thous. lei	Revenue, thous. lei	Profit, lei / q	Yield, q / ha	Profit, lei / ha
Wheat						
2008	36732	3298	6081	75,8	32,18	2439,2
2009	75194	7606	6304	-17,3	18,09	-313,0
2010	30160	3560	3897	11,2	18,34	205,4
2011	34407	3580	4454	25,4	30,12	765,1
2012	27874	3806	5800	71,5	23,82	1703,1
2013	41505	4825	7403	62,1	25,45	1580,8
2014	77580	10286	11005	9,3	29,31	271,6
2015	37935	5764	7450	44,4	18,63	828,0
2016	62198	8874	9309	7,0	26,17	183,0
average	47065	5733	6856	23,9	24,68	588,9
Corn						
2008	987	158	143	-15,2	31,92	-485,2
2009	15753	1527	1796	17,1	21,3	364,2
2010	10747	730	2351	150,8	35,6	5368,5
2011	25979	2646	6539	149,9	19,74	2959,0
2012	6779	1154	1517	53,5	6,5	347,8
2013	8013	1735	2358	77,7	35,36	2747,5
2014	17660	2276	3407	64,0	32,46	2077,4
2015	24290	2728	6027	135,8	31,1	4223,4
2016	17513	2356	3250	51,0	48,63	2482,5
average	14191	1701	3043	94,6	29,18	2759,5
Sunflower						
2008	8907	1323	2214	100,0	18,8	1880
2009	19546	3180	4413	63,1	13,5	851,8
2010	21864	2631	9888	331,9	19,55	6488,6
2011	16186	2759	6594	236,9	16,8	3979,9
2012	16232	3768	9820	372,8	13,6	5070,1
2013	16707	4204	6662	147,1	13,5	1985,9
2014	17086	3959	6704	160,7	14,91	2396,0
2015	26672	6615	15172	320,8	17,95	5758,4
2016	17949	4522	9824	297,0	18,37	5456,8
average	17905	3662	7921	237,9	16,33	3884,4

Source: Developed based on the forms 7 and 9 AIC of the collective farm "Pobeda" for 2008-2016.

The area of cultivation of agricultural crops can be conditionally divided into two parts:

• the first – commercial crops;

• the second – crops for internal needs and products that were not sold this year.

The analysis of efficiency is carried out on the first part, thus potential indicators of the efficiency of production and sales of crops are identified. For example, the area of sunflower sowing in 2016 was 1260 ha and the gross harvest amounted to 23142 q or 18.37 q/ha. It was sold 17949 q or 76.6% (i.e. 977 ha of commercial crops). The rest of the seeds were released in the form of rent and a small proportion of the seeds remained for sale in 2017.

Potential indicators of profit per unit area in the production of wheat were the most favourable in 2008, 2012 and 2013, when profits received from one hectare of crops amounted to 2439.2, 1703.1 and 1580.8 lei respectively. The profit of 1873 lei per hectare of land is a real indicator, which can be reached on average per year:

$$E_{wheat} = \sqrt[3]{2439{,}2 \cdot 1703{,}1 \cdot 1580{,}8} = 1873 \text{ lei/ha}$$

In the cultivation of corn:

$$E_{corn} = \sqrt[3]{5368{,}5 \cdot 2959{,}0 \cdot 4223{,}4} = 4063 \text{ lei/ha}$$

In the cultivation of sunflower:

$$E_{sunflower} = \sqrt[3]{6488{,}6 \cdot 5456{,}8 \cdot 5758{,}4} = 5732 \text{ lei/ha}$$

It is also important to analyse the profit obtained from each hectare of land in processing on average for the enterprise (table 2), and also on average for all cultivated crops.

Table 2

Indicators of sales of crop production in the collective farm "Pobeda" for 2008-2016

Year	Cost of sales, thous. lei	Revenue, thous. lei	Level of profitability,%	Profit, thous. lei	Sown area, ha	Profit per hectare, lei
2008	16685	20207	21,1	3522	5217	676
2009	23198	23090	-0,4	-108	5197	-21
2010	18049	24625	36,5	6576	5199	1265
2011	18317	25889	41,4	7572	5015	1510
2012	18708	26374	41,0	7666	5274	1454
2013	22410	27584	23,1	5174	5303	976
2014	24802	27886	12,5	3084	5495	562
2015	24354	36439	49,7	12085	5221	2315
2016	27791	36049	29,8	8258	5499	1502
average	21590	27571	27,7	5981	5269	1135

Source: Developed based on the forms 7 and 9 AIC of the collective farm "Pobeda" for 2008-2016.

The years 2011, 2015 and 2016 were the most favourable in the sale of all crop production. On average in the crop production, the potential profit indicator per hectare of land is 1738 lei:

$$E_{crop} = \sqrt[3]{1510 \cdot 2315 \cdot 1502} = 1738 \text{ lei/ha.}$$

The potential indicator of the level of profitability of crop production for 9 studied years was 44.0%:

$$E_{profit} = \sqrt[3]{41{,}4 \cdot 41{,}0 \cdot 49{,}7} = 44{,}0\%$$

Figure 1 shows that there is a favourable trend in profit indicators per unit area. Thus, according to the trend equations, average annual profit from sunflower sales increased by 314.1 lei per hectare, and from sales of entire crop production – by 139.5 lei/ha (current prices).

In a formalized form, the minimum value of the profit of a separate crop per hectare of productive land necessary to ensure at least the simple reproduction is determined by the expression [16, p.107-108]:

$$P_{min} \geq R_{min} \cdot \frac{Z}{S}, \text{ lei/ha} \quad (2)$$

where, R_{min} – minimum coefficient of profitability;

Z – actual cost of production of a given crop, lei;

S – cultivation area of a given crop, ha.

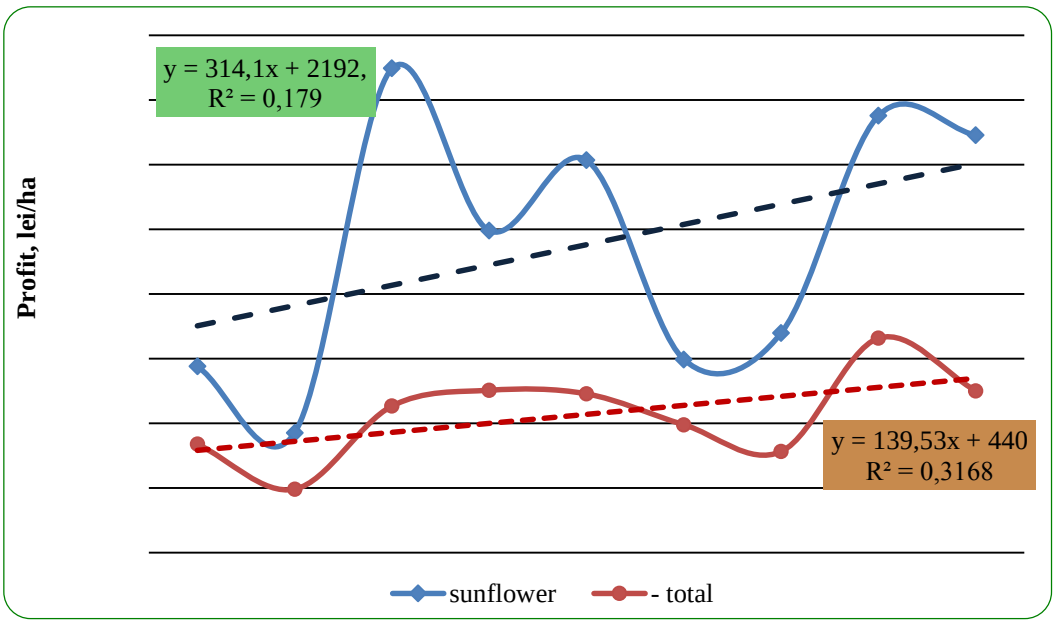

Figure 1. Dynamics of the profit per hectare of land in the production of sunflower and all crop production in the collective farm "Pobeda" for 2008-2016

Source: Developed based on the forms 7 and 9 AIC of the collective farm "Pobeda" for 2008-2016.

Studies have shown that in the southern zone of the Republic of Moldova, the minimum coefficient of profitability necessary to ensure at least the simple reproduction is 0.213 for cereals, and 0.814 for sunflower [16, p.107-108]. In the given example, according to the calculations, the profit per hectare should be not less than 640 lei/ha in the production of wheat, 745 lei/ha – maize, and 2719 lei/ha – sunflower.

The value of the minimum profit from the realization of all crops is defined as:

$$P_{min} = 0{,}44 \sum_{i=1}^{n} \alpha_i \frac{Z_i}{S_i}, \text{ lei/ha} \quad (3)$$

where: P_{min} – the minimum profit from the sale of a group of crops, lei/ha;

0,44 – the potential coefficient of profitability of sales of crop production;

Z_i – the actual production cost of a given crop, lei;

α_i – the share of the area of a given crop in the structure of the cultivated cash crops (in decimal fractions);

S_i – the cultivation area of a given crop, ha;

n – the number of cultivated crops.

The calculated estimation of reserves of increasing land efficiency is characterized by the difference between the potential value and the achieved level of its use.

The coefficient of use of the normative land efficiency in agriculture is determined by the ratio of the actual level (Ea) to the potential level (Ep):

$$K = \frac{Ea}{Ep} \quad (4)$$

The potential level of efficiency of land resources is defined as a sum of the actual indicator and the real reserve of its growth (ΔE):

$$Ep = Ea + \Delta E \quad (5)$$

Calculations show that, in the agricultural production of the collective farm, 27571 thousand lei were obtained from the sale of all types of crop production on average for 2008-2016, the cost of goods sold amounted to 21590 thousand lei, hence the profit from sales reached 5981 thousand lei. Thus, the level of profitability of all products sold was 27.7% on average for 9 years, and the profit per one hectare of used land reached 1135 lei.

Based on the data in table 2, there were found real reserves for increasing the efficiency of land use on the collective farm in the production of wheat, corn and sunflower (figure 2).

The volume of the reserves is clearly presented in figure 2, which shows that the reserve of profit per 1 ha of sown area in the production of wheat is more than 2 times higher than the actual indicator, and in the cultivation of corn and sunflower it is higher with almost 50%.

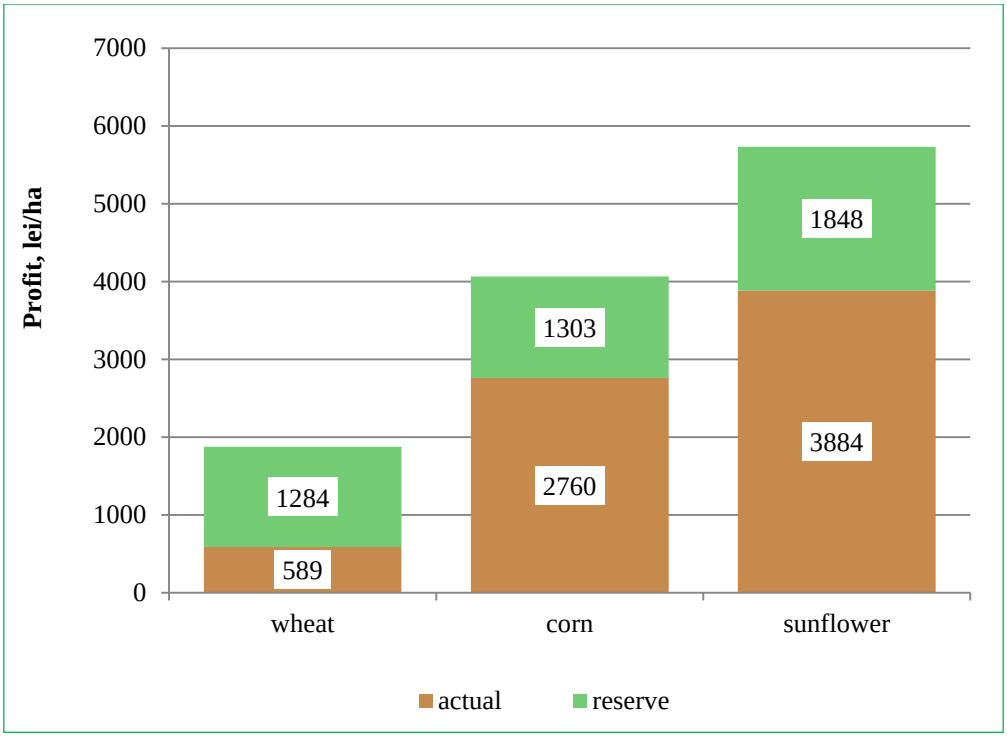

Figure 2. Indicators of actual profit per hectare of sawn area and reserves of its growth in the production of wheat, corn and sunflower on the collective farm "Pobeda" on average for 2008-2016
Source: Performed according to the table 2.

Conclusions. The study allowed to reveal the main problems of effective land use in agriculture and to consider methodical approaches to determining the efficiency of land use in the production of basic agricultural crops. Calculations were made on the example of "Pobeda" collective farm in the Ceadir-Lunga district.

Taking into account the unpredictability of weather conditions, it should be considered economically independent that enterprise, which is able to ensure an average annual profitability sufficient to maintain at least simple reproduction. To justify the indicators of the potential efficiency of land use, characterizing the profit per unit area of certain crops, it is necessary to investigate at least a nine-year period. The corresponding formulas were presented.

A methodology for calculating potential yield indicators of the main cultivated crops was propoed and was tested on the basis of the "Pobeda" collective farm in the Ceadir-Lunga district. A comparison was made between the actual and minimum indicators of the profit per unit area. On this basis, the reserves of land use efficiency have been identified, which indicates that cultivation of an agricultural crop according to the technology developed by the enterprise makes it possible to obtain a profit amount not lower than the minimum one. Calculations of profit per hectare of crops on the "Pobeda" collective farm on average for 2008-2016 showed that the reserve of profit per 1 hectare of sown area in the production of wheat is more than 2 times higher than the actual indicator, and in the cultivation of corn and sunflower it is almost 50%.

Thus, the proposed modern methodological toolkit for the economic evaluation of the efficiency of land use in agriculture allows specialists of agricultural enterprises, as well as professors and students of higher educational institutions, to determine the normative indicators of land productivity and volume of profit for each cultivated crop, and on this basis to identify reserves for improving land use efficiency.

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