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ECOLOGICAL AND ECONOMIC ESTIMATION OF AGRICULTURAL LAND REPRODUCTION EFFICIENCY IN LVIV REGION

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Abstract

One has proposed to determine the ecological and economic efficiency of the process of land resources reproduction, depending on the yielding capacity of cereals and legumes on the humus stock in soils and the cost of their cultivation due to the use of index method and rating. One has calculated the project indicators of yielding capacity, production costs and minimum profit at 25 % for growing cereals and legumes for the administrative districts of Lviv region based on the range of changes in actual fertility due to humus stock, taking into account the qualitative characteristics. Considering the calculations, we have established that the highest yielding capacity of cereals and legumes at the level of 1.205 will be concentrated in Sokal district of Lviv region, which depends on humus content in soil at the level of 1.159 and the level of socially necessary costs of 1.038. The corresponding project values of the gross production of grain and leguminous crops growing for the researched administrative area are 408.71 million UAH concerning production costs of 286.73 million UAH, which provides a profit of 122 million UAH at 42.5 % of profitability, taking into account the predicted yielding capacity at the level of 45.3 c/ha.

Key words**:** *agricultural land reproduction, grain and legume yielding capacity, humus content, costs, profit*

INTRODUCTION

Ensuring and increasing cost-effectiveness of the process of land resources use and reproduction presupposes the rational application of ecological mechanisms of the preservation and reproduction of soil and agricultural landscape biological productivity, as the main fundamental of the formation and permanent support of the biological productive potential of crops.

In modern research S. Bohatyrchuk-Kryvko [1], V. Chudovska [2], M. Stupen [8] have different approaches to single out the components of agricultural land use efficiency. O. Dorosh [3], P. Sabluck [6], M. Khvesyk [4], M. Shchuryk [7] include the costs of implementing a set of environmentally-friendly measures of the agricultural system, indicators of the intensity and productivity of the agroecosystem per unit of cost, the orientation of reproduction of soil fertility to the indicators of ecological and economic efficiency. Schemes and methods for their definition are not given. Accordingly, we consider that one should specify the method of calculation and principles for determining the efficiency of land resources reproduction in

agriculture considering the yielding capacity of crops, the cost of their cultivation, depending on the content of humus in the soil.

MATERIALS AND METHODS

One has determined the dependence of the yielding capacity of cereals and legumes on the humus stock in soils and the cost of their production (formula 1). On its basis we have proposed to determine the necessary level of costs, using the index method and rating estimates.

$$PCh = \frac{Yc}{Hs \times GYexp} \quad (1)$$

where:

PCh – production costs on 1 hundredweight of humus, UAH/cwt;

Yc – yielding capacity of cereals and legumes, cwt/ha;

Hs – humus stock in soil, cwt/ha;

GY_{exp} – grain yield per 1 UAH of expenses, kg/UAH.

RESULTS AND DISCUSSIONS

Considered calculations of profit and loss from humus allow carrying out targeted management of soil fertility wear. Due to humus predicting, we establish optimal ratios, technical and technological standards for land resources use, designing a systematic increase in the yielding capacity of true fertility without reducing the initial potential for soil fertility. One has analyzed grain production by the parameters of humus stock in soils, yielding capacity and production costs per 1 hectare of crops and 1 hundredweight of humus in the regions of Lviv region to identify the level of socially necessary expenditures to support soil fertility as based on the example of grain and leguminous crops production (Table 1) [5].

Table 1. Ecological and economic indicators of efficiency of grain and leguminous crops production in the context of administrative districts of Lviv region for 2018.

District	Humus content		The yielding capacity of grains, cwt/ha	Production costs, UAH/ha	Grain yield per 1 cwt of humus, kg/cwt	Production costs per 1 cwt of humus, UAH/ha	Grain yield per 1 UAH of humus, kg/UAH	
	cwt/ha	%					1 ha	1 cwt
Brody	840	2.8	60.9	10,072.9	7.250	11.99	0.605	0.605
Busk	780	2.6	47.2	7,165.4	6.051	9.19	0.659	0.659
Horodok	780	2.6	40.6	6,232.1	5.205	7.99	0.651	0.651
Drohobych	810	2.7	45.9	4,331.1	5.667	5.35	1.060	1.060
Zhydachiv	780	2.6	49.1	11,395.1	6.295	14.61	0.431	0.431
Zhovkva	780	2.6	33.8	6,085.0	4.333	7.80	0.555	0.555
Zolochiv	1,050	3.5	57.0	11,495.2	5.429	10.95	0.496	0.496
Kamianka-Buzka	750	2.5	47.2	8,597.5	6.293	11.46	0.549	0.549
Mykolaiiv	720	2.4	40.8	6,147.0	5.667	8.54	0.664	0.664
Mostyska	660	2.2	47.3	6,897.3	7.167	10.45	0.686	0.686
Peremyshliany	660	2.2	43.8	6,958.5	6.636	10.54	0.629	0.629
Pustomyty	780	2.6	43.8	8,048.7	5.615	10.32	0.544	0.544
Radekhiv	1,080	3.6	51.3	7,952.5	4.750	7.36	0.645	0.645
Sambir	840	2.8	54.7	7,160.8	6.512	8.52	0.764	0.764
Sokal	600	2.0	45.3	6,553.1	7.550	10.92	0.691	0.691
Staryi Sambir	570	1.9	30.9	8,858.1	5.421	15.54	0.349	0.349
Stryi	660	2.2	46.9	6,326.3	7.106	9.59	0.741	0.741
Yavoriv	480	1.6	35.7	3,964.1	7.438	8.26	0.901	0.901
Lviv region	750	2.5	47.0	7891.3	6.267	10.52	0.596	0.596

Source: on the basis of data [5].

Table 2. Ecological and economic indicators of efficiency of cereals and legumes production in the context of administrative districts of Lviv region for 2018 on the basis of index method of estimation

District	Humus stock, cwt/ha	The yielding capacity of grains, cwt/ha	Grain yield per 1 cwt of humus, kg/cwt	Production costs per 1 cwt of humus, UAH/ha	Grain yield per 1 UAH of humus, kg/UAH	
					from 1 ha of sowing	from 1 ha of humus
Brody	1.12	1.296	1.157	1.140	1.015	1.015
Busk	1.04	1.004	0.966	0.874	1.106	1.106
Horodok	1.04	0.864	0.831	0.760	1.092	1.092
Drohobych	1.08	0.977	0.904	0.509	1.779	1.779
Zhydachiv	1.04	1.045	1.004	1.389	0.723	0.723
Zhovkva	1.04	0.719	0.691	0.741	0.931	0.931
Zolochiv	1.40	1.213	0.866	1.041	0.832	0.832
Kamianka-Buzka	1.00	1.004	1.004	1.089	0.921	0.921
Mykolaiiv	0.96	0.868	0.904	0.812	1.114	1.114
Mostyska	0.88	1.006	1.144	0.993	1.151	1.151
Peremyshliany	0.88	0.932	1.059	1.002	1.055	1.055
Pustomyty	1.04	0.932	0.896	0.981	0.913	0.913
Radekhiv	1.44	1.091	0.758	0.700	1.082	1.082
Sambir	1.12	1.164	1.039	0.810	1.282	1.282
Sokal	0.80	0.964	1.205	1.038	1.159	1.159
Staryi Sambir	0.76	0.657	0.865	1.477	0.586	0.586
Stryi	0.88	0.998	1.134	0.912	1.243	1.243
Yavoriv	0.64	0.760	1.187	0.785	1.512	1.512
Lviv region	1.00	1.00	1.00	1.00	1.00	1.00

Source: on the basis of data [5].

We have made the calculation of the corresponding indices in each administrative district (Table 2) due to formula (1), taking the investigated parameters from Table 1 as a unit in Lviv region.

It allows establishing the dependence of the level of costs per 1 cwt of humus and yields of cereals and legumes, acceptable for each of the regions of Lviv region considering the actual state of land fertility.

Thus, one has proposed methods of for determining the level of socially necessary costs and the minimum amount of profit by differentiation of soil quality as based on the application of formula (1) on the dependence of the yielding capacity indicators of cereals and legumes on humus stock in soils and financial investments in production.

Closer inspection of the obtained calculations in Table. 2 shows that the rate of grain yield per 1 hundredweight of humus is interdependent with the indicator of humus stock in soils and not related to the number of costs in agricultural production. Considering the index of potential fertility (humus stock in soils) for constant value and realizing the range of change of real fertility due to the yielding capacity of cereals and legumes for each district of Lviv region, one can calculate the corresponding project yielding capacity indicators. Using the project values of grain yield per 1 hundredweight of humus or 1 UAH of costs, we can calculate and substantiate the cost range per 1 hectare of sowing, which will ensure that the predicted yielding capacity values for each district of the region. According to the researches, the value of grain yield per 1 UAH of expenses is characteristic for each district of Lviv region in a certain interval considering soil quality, humus stock in them, degree of development of rural territories and arable land for the needs of the agrarian branch, the level of agriculture, observance technological discipline in agricultural production processes. Another significant aspect is that the production cost indices, which are based on the proposed approaches, firstly, per 1 hundredweight of humus or 1 hectare, and then the overall gross yielding capacity of cereals and legumes in the districts of Lviv region, are the foundation for calculating the value of profit due to the provided methodology (Table 3).

Table 3. Actual and project indicators of gross production, production costs and profit on the basis of differentiation of soil quality in the context of districts according to the actual content of humus and grain yield per 1 UAH of costs

Districts	Sowing areas, ha	Gross output, t	The yielding capacity, cwt/ha	Indices on gross yielding capacity of cereals and legumes							
				Gross products, mln. UAH		Production costs, mln. UAH		Profit/ Loss, mln. UAH		Profitability, %	
				actual	project	actual	project	actual	project	actual	project
Brody	20,615	125,169	60.9	134.09	314.61	207.65	252.13	-73.56	+62.5	-35.42	+24.8
Busk	17,762	83,791	47.2	87.84	219.78	127.27	161.68	-39.43	+58.1	-30.98	+35.9
Horodok	17,068	69,216	40.6	75.14	193.60	106.37	144.18	-31.23	+49.4	-29.36	+34.3
Drohobych	8,858	40,690	45.9	42.50	113.26	38.36	51.80	+4.14	+61.5	+10.80	+118.7
Zhydachiv	19,832	96,731	49.1	101.19	245.40	225.99	276.12	-124.81	-30.7	-55.23	-11.1
Zhovkva	18,867	63,567	33.8	68.00	171.20	114.81	149.52	-46.81	+21.7	-40.77	+14.5
Zolochiv	27,088	154,221	57.0	161.73	385.46	311.38	376.86	-149.65	+8.6	-48.06	+2.3
Kamianka-Buzka	17,225	80,974	47.2	85.53	213.14	148.09	188.23	-62.57	+24.9	-42.25	+13.2
Mykolaiiv	9,200	37,529	40.8	39.18	106.25	56.55	77.57	-17.37	+28.7	-30.72	+37.0
Mostyska	14,944	70,615	47.3	73.28	169.50	103.07	119.84	-29.79	+49.7	-28.90	+41.5
Peremyshliany	12,353	54,015	43.8	56.20	129.93	85.96	100.20	-29.76	+29.7	-34.62	+29.6
Pustomyty	14,691	63,662	43.8	66.63	175.72	118.24	156.64	-51.62	+19.1	-43.66	+12.2
Radekhiv	27,294	140,085	51.3	148.64	394.02	217.06	296.25	-68.42	+97.8	-31.52	+33.0
Sambir	12,846	69,931	54.7	73.87	182.80	91.99	116.00	-18.12	+66.8	-19.70	+57.6
Sokal	37,393	169,178	45.3	177.26	408.71	245.04	286.73	-67.78	+122.0	-27.66	+42.5
Staryi Sambir	6,215	19,009	30.9	20.31	46.14	55.05	64.12	-34.74	-18.0	-63.11	-28.1
Stryi	8,691	39,233	46.9	41.44	98.58	54.98	64.53	-13.54	+34.1	-24.63	+52.8
Yavoriv	11,027	39,320	35.7	41.70	90.96	43.71	48.96	-2.01	+42.0	-4.60	+85.8
Lviv region	303,679	1,421,892	47.0	1499.72	3659.06	2396.42	2931.36	-896.70	+727.7	-37.42	+25.0

Source: on the basis of data [2].

The level of minimum profit is 25 % of the average cost of production per 1 ton of cereals and legumes since profitability indicators at such a level will ensure minimal requests for simple reproduction. Setting the profitability level of more than 30 % is impractical because of the large gap in formulated profit, as, on one hand, they will receive excessively high rates of profitability on the best lands, on the others hand, they will not get any profit on the worse ones at all. Similarly, setting a profitability level below 25 % will not guarantee a profit on poor quality land at all.

CONCLUSIONS

In summary, one has proposed to calculate the production costs and the minimum amount of profit on the example of growing cereals and legumes in Lviv region considering the qualitative characteristics of soils and natural regional features.

At the same time, the increase of crop yielding capacity should be accompanied by the improvement of soil quality characteristics and environmental sustainability of agro-landscapes due to the consistent environmentalization of the production process, the increase in gross agricultural production, simultaneously with increasing the yielding capacity in terms of value and the reduction of production costs.

REFERENCES

[1]Bohatyrchuk-Kryvko, S., 2014, Formation of System of Land Resources Reproduction in Agriculture. Balanced Nature Use, 4: 134-137.

[2]Chudovska, V., 2015, The Mechanism of State Regulation of Ecologically Safe Land Resources Use. Balanced Nature Use, 1: 65-69.

[3]Dorosh, O., 2012, Economic and Ecological Principles of Rural Land Use Development. Agrosvit, 20: 2-5.

[4]Khvesyk, M., 2009, Strategic Imperatives for Rationalization of Land Use in the Context of Socio-Economic Uplift of Ukraine. Economics of Agro-Industrial Complex, 3: 24-30.

[5]Main Statistical Office in Lviv Region, 2020. Agriculture, Forestry and Fisheries. URL: http://database.ukrcensus.gov.ua/statbank_lviv/Database/04SILGOSP/databasetree_uk.asp. Accessed on 17.04.2020.

[6]Sabluk, P., 2007, Economic Mechanism of Agro-Industrial Complex in the Market System of Management. Economics of Agro-Industrial Complex, 2: 3-10.

[7]Shchuryk, M., 2007, Paradigm of Indicators of Land Resources Reproduction in the Carpathian Macro-Region. Regional Economics, 3: 265-269.

[8]Stupen, M., Stupen, R., Ryzhok, Z., Stupen, O., 2019, Methodological foundations of the organization and protection of lands in the context of the balanced nature use. Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 19 (1): 565-571.