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Ecological and Economic Efficiency in Agricultural Production

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***Abstract*—The article defines a set of measures aimed at preventing erosion by agricultural forestry in agricultural production, taking into account environmental and economic efficiency. By types of agricultural landscape to protect the soil from erosion, research and production experiments on the implementation of sets of measures in the Volga steppe have been designed and laid. The increase in profitability in agricultural production under the influence of anti-erosion techniques depends on the moisture of the growing season, plant growth and the type of agricultural landscape. An economic assessment of the restoration by type of agricultural landscape was conducted on the experimental site of FC Vyazovsky, which serves as a research and production hospital. Capital expenditures for conducting anti-erosion techniques are calculated according to the agricultural steepness types of slope. When calculating capital costs, 5 types of agricultural landscape were combined into 3 groups according to the degree of saturation with anti-erosion techniques, depending on the slope. The ecological and economic efficiency of agro forestry in agricultural production by type of agricultural landscape when using sloping lands in agricultural production has a payback period with reduced erosion.**

Keywords—economy; ecology; profitability; payback; pasture; agricultural forestry; ecological and economic efficiency

I. INTRODUCTION

At present, the most acute issue is the ecological protection of the steppe landscapes of the Saratov region, including the Volga Upland. The permanent degradation of these territories leads to significant damage, both ecological and economic. The economic losses, in this case, include the costs of localization and liquidation of the effects of erosion, losses due to untapped opportunities, the economic equivalent of environmental damage, etc. In this regard, a complex of measures is needed to prevent the risks of erosion by agro forestry, taking into account both environmental and economic efficiency [1] [2] [3]. One of the main tasks of environmental and economic research is the development and implementation of a strategy for sustainable environmental-oriented development of the Russian Federation in general and its regions in particular, which involves strengthening the economy, maintaining a favorable environmental quality and balancing socio-ecological-economic interests at absolutely all levels of government. In these conditions, the need to develop and use non-traditional approaches to solving environmental and economic problems, finding new reserves for the development of the country becomes obvious.

II. OBJECTIVES AND METHODS

Ecological and economic assessment of agro technical and forest reclamation techniques is given on the basis of crop productivity. According to the methods of VNIALMI and VNIIZ and ZPE, profitability of agricultural land was calculated under the influence of agro technical and land reclamation anti-erosion measures. The economic assessment of pastures under the influence of protective plantings by type of agricultural landscape is given in "Table I". The costs take into account the cleaning and transportation of herbs to the place of feeding. Products are estimated on the basis of the conversion factor in pasture

grass feed units in relation to oats: 0.23 control grasses, protective forest plantations, 0.37 impacted by forest belts and bush curtains (the difference in conversion factors is the prevalence of leguminous grasses under protection of plantations with more valuable feed quality compared to other types of grassy plants. The price of oats in the third quarter of 2018 was 4.5 thousand rubles per ton.

III. RESULTS AND DISCUSSION

Regardless of the wetting of the growing season of grass pastures, there is a regular tendency for profitability to decline, with a greater decrease occurring on erosion-type agricultural landscape types (> 30): almost 4 times on steep slopes (> 80). With an increase in the steepness of the slope, the decrease in profitability is: for arid years, 31.1 (9.8) - 273.1 (92.5)%, middle years - 37.3 (21.9) - 297.4 (123.2)%, medium-humid years - 38.9 (28.7) - 158.2 (91.6)%, medium-humid years - 38.9 (28.7) -158.2 (91.6)%, wet years - 0.1 (0.1) - 29.0 (37.8)%. There is less reduction in the profitability of pasture grasses on the slopes with the use of anti-erosion techniques (shown in brackets) as compared to open agricultural landscape [4] [5] [6].

TABLE I. PASTURE PROFITABILITY BY TYPE OF AGRO-FORESTS IN 2015-2018

Type of agricultural landscape Slope steepness Degree	**Herb productivity, Ie / ha**	**Costs, thousand rubles / ha**	**Product valuation, thousand rubles / ha**	**Profit, RUB / ha**	**Profitability, %**
2015 г.					
Low-sloping flat (Placor), <10	0.58/1.32	1.04/1.20	2.61/5.94	1.57/4.74	151/395
Gently sloping, 1-3 º	0.56/1.29	1.04/1.20	2.52/5.80	1.48/4.60	142/383
Sloping square,3-5 º	0.48/1.11	1.03/1.18	2.16/5.00	1.13/3.82	110/324
Sloping slope-Ravine5-8 º	0.44/1.01	1.03/1.18	1.98/4.54	0.95/3.36	92/285
Steep ravine,>8 º	0.28/0.64	0.91/1.04	1.26/2.88	0.35/1.84	38/177
2016 г.					
Low-sloping flat (Placor),,<1 º	0.72/1.50	1.13/1.27	3.24/6.75	2.11/5.48	187/431
Gently sloping, 1-3 º	0.69/1.44	1.13/1.27	3.10/6.48	1.97/5.21	174/410
Sloping square,3-5 º	0.62/1.31	1.11/1.24	2.79/5.90	1.68/4.66	151/376
Sloping slope-Ravine5-8 º	0.58/1.20	1.11/1.24	2.61/5.40	1.50/4.16	135/335
Steep ravine,>8 º	0.38/0.78	0.99/1.08	1.71/3.51	0.72/2.43	73/225
2017 г.					
Low-sloping flat (Placor),,<1 º	1.78/3.29	1.83/1.91	8.01/14.80	6.18/12.89	338/675
Gently sloping, 1-3 º	1.77/3.25	1.83/1.91	7.96/14.62	6.13/12.71	335/665
Sloping square,3-5 º	1.75/3.24	1.81/1.89	7.88/14.58	6.07/12.69	335/671
Sloping slope-Ravine5-8 º	1.70/3.09	1.80/1.88	7.65/13.90	5.85/12.02	325/639
Steep ravine,>8 º	1.29/2.36	1.60/1.69	5.80/10.62	4.20/8.93	262/528
2018 г.					
Low-sloping flat (Placor),,<1 º	0.46/1.16	1.05/1.20	2.07/5.22	1.02/4.02	97/335
Gently sloping, 1-3 º	0.44/1.10	1.04/1.19	1.98/4.95	0.94/3.76	90/316
Sloping square,3-5 º	0.39/1.00	1.01/1.11	1.76/4.50	0.75/3.39	74/305
Sloping slope-Ravine5-8 º	0.38/0.95	1.01/1.10	1.71/4.28	0.70/3.18	69/289
Steep ravine,>8 º	0.26/0.64	0.93/1.05	1.17/2.88	0.24/1.83	26/174
2018 гг.					
Low-sloping flat (Placor),,<1 º	0.88/1.82	1.26/1.39	3.96/8.19	2.70/6.80	214/489
Gently sloping, 1-3 º	0.86/1.77	1.26/1.39	3.87/7.96	2.61/6.57	207/473
Sloping square,3-5 º	0.81/1.66	1.24/1.36	3.64/7.47	2.40/6.11	194/449
Sloping slope-Ravine5-8 º	0.77/1.56	1.24/1.35	3.46/7.02	2.22/5.67	179/420
Steep ravine,>8 º	0.55/1.11	1.11/1.22	2.48/5.00	1.37/3.78	123/310

The numerator and denominator are respectively control (agricultural landscape) and with a complex of anti-erosion techniques (agricultural forestry).

A greater drop in the value of pasture land profitability is natural for erosion-hazardous types of agricultural landscape (>30), especially steep slope (>80) due to low grass productivity.

Increasing the profitability of pasture grasses under the influence of anti-erosion techniques depends on the moistening of the growing season of plants; type of agricultural landscape and is: for dry years, 3.4-6.7 times; for average years - by 2.6-4.6 times; for medium-humid years, 2.3-3.1 times; for wet years 99.7-101.6%; in 2015-2018, on average, 2.3-2.5 times.

The greater value of increasing profitability corresponds to the slopes with increasing steepness, which indicates the increasing role of anti-erosion techniques. Anti-erosion techniques should be applied comprehensively and differentially according to the elements of the relief from the watershed to the hydrographic network and taken into account at all stages of land protection from erosion: exploration - design- construction (creation) - operation [7] [8] [9].

The recoupment of investments in the complex of anti-erosion receptions depends on capital expenditures (degree of saturation with anti-erosion receptions by types of agricultural landscape) and profits of agricultural and forestry purposes: crop rotation and grass grazing (including

increasing productivity of land under the influence of protective forest stands - ZLN), tree (thinning in ZLN) and non-timber products ZLN (mushrooms, berries, medicinal raw materials, tapping, etc.). Profit from agricultural production prevailed in efficiency — up to 90% or more (Methodical recommendations for determining the economic efficiency of actual capital investments in protective deforestation and other anti-erosion measures on eroded lands [10] [11] [12] [13]. An economic assessment of the restoration by type of land agricultural landscape was carried out at the experimental site of FC Vyazovsky, which has served as a research and production hospital since 1983.

Capital expenditures for conducting anti-erosion techniques are calculated according to the agricultural steepness types of slopes. When calculating the capital costs, 5 types of agricultural landscape were combined into 3 groups according to the degree of saturation with anti-erosion techniques, depending on the steepness: 1: 0–30 - forest belt with inter-strip accommodation of mulled slots; 2.3- 80- forest lanes with inter-band placement of shrub wings and preliminary backfilling of ravines; 3.More than 80 - protective forest stands on terraces ("Table II").

The ameliorative arranged area of the Safarov site on a low pathologist and canopy types of the agricultural landscape (0-30) is 12.0 hectares: a forest belt with a shaft — a ditch in the lower edge 27.0 m wide, of dense construction — 0.61 hectare; pasture with a mulch slit -12.0 ha. The area share of the forest belt in ameliorative arranged area is 0.051. Outcome from the price of creating 1 hectare of forest belt, taking into account the installation of a shaft-ditch with a PPN plow, is 50-41 thousand rubles / ha, the cost will be 41 * 0.051 = 2.1 thousand rubles / ha for one amelioration. The cost of the device cracks through 1.4m with the introduction of crushed straw with a dose of 5 t / ha-1.3 thousand rubles / ha.

Capital expenditures for the creation of a complex of anti-erosion receptions of sites with a steepness of 0-30 (in prices of 2 quarters of 2018 per one ameliorative arranged hectare):

- Design and survey work - 0.1 thousand rubles / ha (2.9%);
- Forest strips with ramparts - ditches in the lower edge - 2.1 thousand rubles / ha (60.0%);
- Capital costs amounted to 3.5 thousand rubles / ha ("Table II")

TABLE II. PAYBACK COSTS FOR ANTI-EROSION TECHNIQUES BY TYPE OF AGRICULTURAL LANDSCAPE

Types of agricultural landscape. Slope steepness, degree	**Expenses, thousand rubles / ha**			**Pasture productivity, tons of cu / ha**	**Product valuation, thousand rubles / ha**	**Profit, thousand rubles / ha**		**Economic efficiency ratio**		**Payback, years**	
	capital	***For products***	***Total***			***From products***	***Taking into account capital costs***	***From products***	***Taking into account capital costs***	***From products***	***Taking into account capital costs***
1. Low-sloping and gently sloping 0-3 º	3.5	1.39	4.89	1.80	8.10	6.71	3.21	4.83	0.656	0.21	1.5
2. Sloping and rolling 3-8 º	4.9	1.36	6.26	1.61	7.24	5.88	0.98	4.32	0.156	0.23	6.4
3. Steep slope >8 º(20)	3.3	1.22	3.52	1.11	5.00	3.78	0.48	3.10	0.136	0.32	7.4

The ameliorative arranged area of the Safarovy experimental plot on the sloping and sloping-steep types of agricultural landscape (3-80) is 28.0 hectares: the flow-regulating forest belt with a ditch shaft in the lower edge of the openwork structure is 0.80 hectares; three bush backstage with ditches - 0.30 ha; pasture - 26.90 ha. The share of the area of PL and QC in the ameliorative arranged area is 0.039. Based on the price of creating 1 ha of PL and KK, taking into account the device of a ditch shaft with a PPN-5 — 41 thousand rubles / ha plow, their cost will be for one ameliorative arranged ha- 41 * 0.039 = 16 thousand rubles / ha The volume of backfill of the ravines is 0.21 thousand m3 with an average depth of the ravines of 12 m and a width of 3.0 m along the top. According to the price of moving 1 m3 of soil with a scraper of 12.1 rubles the cost of backfilling on one ameliorative arranged hectare will be 2.5 thousand rubles / ha. The cost of fertilizers is 0.6 thousand rubles / ha.

Capital expenditures for the creation of a complex of anti-erosion receptions of the experimental site with a steepness of 3-80 were distributed as follows (in prices of the 2nd quarter of 2018 per one ameliorative arranged hectare):

- Design and exploration work - 0.2 thousand rubles / ha (4.1%);
- Backfilling of ravines with the introduction of organic-mineral fertilizers -3.1 thousand rubles / ha (63.3%);
- Forest belts and bush backstage with ramparts-ditches in the lower edge - 1.6 thousand rubles / ha (32.6%)

Thus, the costs amounted to 4.9 thousand rubles / ha ("Table II").

The amelioration-arranged area of the Safarov site on a steep slope agricultural landscape type (200) is 9.0 hectares: For the area of protective forest plantations in the ameliorative arranged area is 0.0. The cost of plantings on ameliorative arranged ha- 40 * 0.044 = 1.8 thousand rubles / ha. The cost of building of 9 contour terraces is 1.3 thousand rubles / ha.

Capital expenditures for the creation of a complex of anti-erosion techniques for a site with a steepness of 200

- Design and survey work - 0.2 thousand rubles / ha (6.1%);
- Protective forest plantations - 1.8 thousand rubles / ha (54.5%);
- Terraces contour -1.3 thousand rubles / ha (39.4%).

The low coefficient of economic efficiency on the downhill (3-50) and downhill-steep (5-80) types of agricultural landscape is associated with significant capital expenditures for backfilling of ravines, and a steep slope (200) with a small productivity of pasture grass (less by 45.0%). Less capital costs for the steep slope type of agricultural landscape (200) are associated with the construction of 9 stepped terraces between the ravines. The ravines did not fall asleep due to the large steepness of the slope.

IV. CONCLUSION

The recoupment of capital investments in anti-erosion techniques on erosion-hazardous types of agricultural landscape (> 30) is 4.3–5 times slower compared to the plain ones and is more than 6 years. We have previously noted that the cost of anti-erosion measures pays off after 4 years, which was associated with the cultivation of crops in crop rotation.

When using sloping lands for pasture, the payback period increases to 7-10 years, due to the low estimate of the natural grass stand.

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