




Prospects and Risks of Development of Reclamation Infrastructure in the Nonchernozem Belt of the Central Federal District

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Keywords: Reclamation Complex, Reclamation Systems, Reclamation Infrastructure, Technical and Operational Parameters, Reclaimed Lands, Modernization and Technical Re-equipment.


Abstract: The purpose of the research is to analyze the engineering and technical level and technical and operational parameters of the reclamation infrastructure and the ecological state of reclaimed agricultural lands, develop recommendations for the development of reclamation and assess the possible costs and positive effect, taking into account the ecological state and the actual use of the reclamation fund. In this research, an assessment of the technical level and technical and operational parameters of the reclamation complex of the Nonchernozem Belt of the Central Federal District is performed, the reasons of the insufficient efficiency of using the potential of reclaimed lands are analyzed. The main directions and measures were developed for the development of reclamation and restoration at a modern engineering and technical level of the existing reclamation and water-economic fund of the Nonchernozem Belt of the Central Federal District, ensuring the functioning of the reclamation and water-economic complex in the normative mode and the use of at least 90% of the reclaimed land in agricultural production. The research results can be applied in the development of state and regional programs of the development of the reclamation complex and ensuring the food potential of Russia as a whole.

1 INTRODUCTION

The state program of the development of the agro-industrial complex for 2014-2025 is aimed at solving issues of ensuring the country's food security, increasing the competitiveness of Russian agricultural products in the domestic and foreign markets, based on innovative development and increasing the agro-technological level of agricultural production, preserving and restoring soil fertility, socio-economic development of rural areas, reclamation of agricultural lands, ensuring the financial stability of manufacturers (Ministry of Agriculture of the Russian Federation, 2020; Federal State Budgetary Scientific Institution "Rosinformagrotech", 2018; Ugryumova et al., 2019).

As the experience of agricultural production and reclamation development in previous years shows, an important resource and production factor for ensuring food security can be the Nonchernozem Belt of the Russian Federation, especially in the field of creating a fodder base for livestock business. So, as a result of taking a set of reclamation measures in the Nonchernozem Belt of the Russian Federation in 1974-1990, more than 3.1 million hectares of agricultural land were drained, the provision of agricultural enterprises with technological equipment and machinery increased 4 times, which allowed to produce 30% of agricultural and livestock products, of which 31% is meat, 40% is milk and eggs, 45% is potatoes, 33% is vegetables, 95% is flax fiber, 70% is feed (Consolidated report of the Ministry of Agriculture of the Russian Federation, 2019).

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In connection with the huge potential of the Nonchernozem Belt, on July 28, 2016, in the Tver Region, the President of Russia held a meeting on measures to develop agriculture in the Central Nonchernozem Region. It was especially noted, that in order to increase the efficiency of the crop production industry and the development of the fodder base of livestock business, it is necessary to introduce new technologies, more actively carry out reclamation works, that will increase the yield, and also put into circulation agricultural lands, that are not used for its intended purpose.

2 PURPOSE

To analyze the engineering and technical level and technical and operational parameters of the reclamation infrastructure and the ecological state of reclaimed agricultural lands, develop recommendations for the development of reclamation and assess the possible costs and positive effect, taking into account the ecological state and the actual use of the reclamation fund.

The article was prepared on the basis of the results of many years of research (2011-2019) on the assessment of the engineering and technical level and technical and operational parameters of the main production assets of the reclamation infrastructure and the ecological state of reclaimed agricultural lands. Methodological recommendations for the development of reclamation include: a complex and mechanisms for the implementation of reclamation technologies, an assessment of possible costs and positive effects, taking into account the ecological state and the actual use of the reclamation fund (Kovalev N.G., Olgarenko G.V., Mitrofanov Yu.I., 2015; Olgarenko G.V., Gorodnichev V.I., Turapin S.S., 2015).

3 RESEARCH METHODOLOGY

The FSBSI All-Russian Research Institute "Raduga" conducts information, analytical and static research to assess the actual state, technical level, and efficiency of operation of reclamation systems, including in the development zone of drainage reclamation, based on technical and environmental monitoring of reclamation systems, with the development of methodological recommendations on the development of reclamation, taking into account the

ecological state and the actual use of the reclamation fund.

4 RESEARCH RESULTS

The area of agricultural land in the Nonchernozem Belt is 36.935 million hectares, including: arable land - 25.94 million hectares or 70.6%, feed crops on the area - 9.36 million hectares (25.4%), including hayfields - 3.56 million hectares (9.6%) and grazing lands - 5.81 million hectares (15.7%). Other lands - 1.49 million hectares (4.0%) (Consolidated report of the Ministry of Agriculture of the Russian Federation, 2019).

The main agricultural crops, cultivated in the Nonchernozem Belt of Russia, cereals and grain legumes - 6.3 million hectares (43.64%), feed crops - 6.64 million hectares (44.49%), including perennial grasses - 4.97 million hectares (34.46%). The structure of cultivated areas: grain and grain legumes crops - 30.1%; industrial crops - 0.7%; potatoes and vegetables and cucurbitaceous crops - 3.7%; feed crops - 65.5%.

Reclaimed land in the Nonchernozem Belt covers an area of 4631.36 thousand hectares, including: irrigated lands - 398.5 thousand hectares and drained lands - 4232.86 thousand hectares. In agricultural production, 2323.6 thousand hectares of reclaimed lands are used. Of 4232.86 thousand hectares of drained lands, 960 thousand hectares (15.6%) are in an unsatisfactory state, and on an area of 655 thousand hectares (13.4%) it is necessary to reconstruct drainage systems. Of the 398.5 thousand hectares of irrigated lands, no more than 20% is irrigated, for example, in the Moscow region, out of the itemized irrigated lands of 137.5 thousand hectares, no more than 19.0-22.0 thousand hectares have been irrigated over the past 10 years.

In the Central Federal District, with a total area of reclaimed lands of 1353.06 thousand hectares, agricultural production uses the area of reclaimed lands of 816.7 thousand hectares (60.4% of the accounting area of reclaimed lands), on which are cultivated: grain and grain legumes crops - 43% ; feed crops - 44%, including perennial grasses - 33%; potatoes - 6%; vegetables - 4% and others - 3%.

As of 01/01/2019 in the catchment area of interfarm drainage systems, which are on the balance sheet of the Federal State Budgetary Institution "Management "Meliovodkhoz", there is an area of drained lands of 350.79 thousand hectares or 25.93% of the entire drained area, of which agricultural production is produced on an area of 227.32 thousand

hectares or 16.34%. The drained lands with an area of 123.47 thousand hectares, controlled by the Federal State Budgetary Institution "Management "Meliovodkhoz", have been removed from agricultural production. Agricultural manufacturers use 595.64 thousand hectares of 816.67 thousand hectares of drained lands.

On the balance sheet of the FSBI in the Nonchernozem Belt of the Central Federal District, there are 445 reclamation systems of state ownership. Under the management of 12 regional FSBI on the balance sheet, there are 445 reclamation systems of state ownership, 4913.59 km of principal and regulatory channels, or 9.69% of their total number, 122.7 km of pipelines, 6329 units of hydraulic structures (HS) and 17 pumping stations, with a real estate value of 6257.83 million rubles and an average depreciation of assets of 68.14%. The amount of budgetary funds, allocated for the maintenance of interfarm drainage systems in the regional FSBI amounted to 182469.1 thousand rubles.

For each FSBI NCHB of Central Federal District, indicators of specific book value per hectare were established, taking into account the current state of drainage systems, as well as specific indicators of budgetary content. The highest values of specific indicators of the book value of 49.4 thousand/ha and 47.7 thousand/ha were recorded respectively in the FSBI "Spetsmeliovodkhoz" and the FSBI "Kostromameliovodkhoz". The smallest values 5.7 thousand rubles/ha and 7.5 thousand rubles/ha are in FSBI "Ivanomeliovodkhoz" and FSBI "Ryzanmeliovodkhoz".

The cost of maintaining the reclamation complex is on average 0.479 thousand rubles/ha, with a maximum value of 1.17 thousand rubles/ha, in the FSBI "Spetsmeliovodkhoz"; minimum values: 0.102, in FSBI "Tulameliwodkhoz", 0.108 - FSBI "Orelmeliovodkhoz", 0.110 - FSBI "Ivanomeliovodkhoz".

Out of the area of drained agricultural lands of 1354.0 thousand hectares, the ecological state of the drained lands can be as follows: good, on the area of 132.0 thousand hectares; satisfactory - 428.0 thousand hectares; unsatisfactory - 368.0 thousand hectares, including for the following reasons: close occurrence of groundwater - 140.5 thousand hectares; terms of surface water drainage - 100.8 thousand hectares; the close occurrence of the groundwater and the terms of surface water drainage - 124.25 thousand hectares.

Lands, subject to degradation, include 115.0 thousand hectares of irrigated lands and 650.0 thousand hectares of drained lands.

Areas by the depth of the groundwater level, in total on an area of 1131.90 thousand hectares: groundwater level less than 0.5 m - 131.40 thousand hectares; groundwater level from 0.5 m to 0.75 m - 198.90 thousand hectares; groundwater level from 0.75 m to 1.0 m - 294.48 thousand hectares; groundwater level over 1.0 m - 507.12 thousand hectares.

The problems and risks of reclamation development in the Nonchernozem Belt are as follows:

- technical level and technical and operational characteristics of the hydro land reclaiming systems and hydraulic structures: depreciation of the material and technical base and equipment; machine-technological and resource provision: destruction and siltation of reclamation canals, deterioration of the state of drainage systems;
- a low share of areas of drained lands, used in agricultural production and low efficiency, against the backdrop of a decrease in soil productivity and fertility: violation of agricultural technologies and climatic cropping patterns; lack of a planned complex of ecological reclamation measures;
- development of degradation processes: secondary waterlogging and colonization by tree and shrubby vegetation of reclaimed lands; deterioration of the floristic composition of grassland vegetation in reclaimed hayfields and grazing lands; acidification of soils and a decrease in the reserves of humus and elements of mineral nutrition of plants in the arable layer of drained soils; pollution of soil with heavy metals;
- organization of management of the reclamation complex: strategic and operational planning; interaction with agricultural manufacturers;
- implementation of technological processes: control, monitoring, assessment, statistical research, information and staffing;
- insufficient financing of current maintenance operational activities and maintenance of the property complex, a shortage of specialized reclamation equipment on the balance sheet of the FSBI;
- lack of an integrated approach to the using of reclaimed lands: integrated reclamation, agrochemistry, agricultural technology, cultural equipment, organic and mineral fertilizers, agrolandscape farming systems;
- lack of a modern legal and regulatory framework and human resources, necessary for

the effective and safe use of the reclamation fund;

- lack of strategic investors and funds from agricultural manufacturers for the maintenance of intrafarm drainage systems.

5 RESULTS AND DISCUSSION

A complex program of the development of reclamation should be based primarily on improving the technical level and technical and operational parameters of the reclamation infrastructure through reconstruction, modernization, heavy overhaul and technical re-equipment of the reclamation and water-economic complex, using modern achievements of science and technology (Resolution of the Government of the Russian Federation, 2012).

The main directions of scientific, methodological, regulatory and engineering provisions and implementation of a complex of reclamation measures are aimed at the formation of agrolandscape systems of reclamation agriculture (Kiryushin, 2010), increasing soil fertility, preserving existing and putting into operation new areas of drained lands (Ivanov et al., 2011; Dubenok et al., 2019), due to:

- development of reclamation infrastructure - design of project and performance of construction and installation works for reconstruction, heavy overhaul and technical re-equipment, aimed at improving the engineering and technical level of reclamation systems, including: repair of water intakes, main discharge canals, closed and open regulating and conducting collector arterial drainage, hydraulic structures on interfarm and intrafarm drainage systems;
- implementation of a unified system of agrobiological, agrotechnical and crops of technical reclamation works.

Reclamation of waterlogged lands should be carried out in a complex manner, systematically solving the problems of increasing the fertility of extra watered heavy loamy soils is possible provided, that a complex aggregate of reclamation and agrotechnical measures is applied, which should radically change the physicochemical nature of arable and sub-arable layers, and with this, water and food soil regime (Consolidated report of the Ministry of Agriculture of the Russian Federation, 2019; Kovalev N.G., Olgarenko G.V., Mitrofanov Yu.I., 2015). Reconstruction and technical re-equipment of reclamation systems and hydraulic structures of

federal property and intrafarm irrigation and drainage networks:

- scientific justification and design: integrated schemes of the development of reclamation and use of water resources, rational norms of drainage and irrigation, based on optimization of the seeding structure;
- technologies for the construction, reconstruction and operation of reclamation canals and closed drainage: new integrated technologies, new technical solutions and technical means, equipment and materials, the use of unified structures and assembled products;
- monitoring the technical level and technical and operational parameters of reclamation systems and the ecological state of reclaimed lands using space remote sensing systems and air drones;
- automated systems for planning and control of water distribution and water disposal: modernization of pumping stations, ISS and GPS, automated control systems of pumping stations, instrumental systems for water accounting, means of monitoring the technical condition (Ivanov et al., 2011; Dubenok et al., 2019).

Implementation of a set of operational measures, carried out on drainage systems, aimed at solving the following problems:

- prevention of waterlogging of reclaimed lands and elimination of hyperhydration, creation and constant maintenance of the soil of the optimal water-air regime in the root layer, necessary to obtain high and sustainable crop yields;
- regulation of the water regime, timely disposal of excess ground and surface water from reclaimed lands on single action systems and maintain the required drainage rate and water content of the root zone during dry growing seasons on double action systems;
- creation and maintenance of normal conditions for the productive use of agricultural machinery and vehicles on the drained lands;
- protection and maintenance in good (proper) and efficient state of all elements of drainage systems;
- accounting of drained lands, control over the reclamation state of drained lands and the technical state of drainage systems and water intakes;

- improvement of the technical state and improvement of drainage systems in order to increase the efficiency of the use of drained lands;
- systematic observations of the regime of surface and ground waters in drained areas, soil water content in the root layer;
- compliance with the requirements for environmental protection, accounting for the volumes of water, discharged by the conduction drainage network into water intakes, and control over the quality of water in water intakes.

Ecological safety of reclaimed lands is ensured through the implementation of the following directions:

- increasing and preserving soil fertility: a complex of agroforestral, biological, agrotechnical, crop-engineering and agrochemical reclamations;
- ecological regulation of the admissible impact on water bodies, water distribution and water disposal management technologies, that ensure minimum water discharge;
- adaptive landscape systems of reclamation agriculture with the use of agricultural technologies of "precision agriculture", minimizing the dispersed flow from agricultural lands.
- a complex of land reclamation, agrochemical and agrotechnical measures, including the following main technological measures: regulation of surface and subsurface flow; deep underwinter plowing; leveling of the soil surface; liming the soil; application of mineral fertilizers; increasing the reserves of organic matter in the arable layer; enhancement of biochemical processes; seeding of perennial grasses; use of crop rotations with reduced rotation.

Institutional support is aimed at solving the following issues:

- development and updating of the scientific-methodological and regulatory framework: new reclamation technologies and equipment, operating rules, safety declarations, anti-terrorist security certificates;
- state-private partnership, attraction of off-budget investments: legal framework and interface dossier;
- development of mechanisms of state control and stimulation to reduce the discharge of

contaminated substances from reclaimed lands and reclamation systems;

- training of personnel, higher and secondary technical, vocational education: long-term programs and targeted training, material stimulation.

Target indicators of the complex of construction and installation and maintenance operational works, land reclamation, agroforestral, agro-technological and crop-engineering measures: reconstruction of interfarm drainage systems to service the area of 432.01 thousand hectares; technical re-equipment of drainage systems to service the area of 613.83 thousand hectares; increasing the soil fertility of drained lands due to liming and phosphorization on an area of 759.47 thousand hectares; involvement of drained lands into agriculture, not used in agricultural production - 523.8 thousand hectares; performance of crop-engineering works on drained lands on an area of 608.4 thousand hectares, including 400.33 thousand hectares - on lands not used in agricultural production; on drained lands, used in agricultural production, to clean and repair canals with a total length of 8640.52 km, including 4913.6 km of which are on the balance sheet of the FSBI.

An expert assessment of capital costs, based on aggregated estimates shows, that investments in a set of reclamation measures in the Central Federal District should amount to 51.80 billion rubles, including: Federal budget costs should provide at least 50% of the total investment volume in the development of reclamation infrastructure

By increasing the technical level and quality of operation of reclamation systems, as well as soil fertility, it is possible to significantly develop the fodder base of livestock business, by increasing the area of fodder lands and achieving an average yield of feed crops of at least 5.0 tons of feed units per hectare, with an annual gross yield up to 5.2 million tons of feed units.

6 CONCLUSIONS

The implementation of the program of the development of drainage reclamation of the Nonchernozem Belt in the Central Federal District by 2025 should ensure an increase in agricultural products from reclaimed lands by 1.5 - 2.0 times compared with the existing level of production. Fulfillment of target indicators and bringing the drainage systems to the planned capacity can provide

an eco-economic effect in the amount of up to 26.8 billion rubles annually.

The main factors of the formation of eco-economic efficiency: increasing the technical level of the HS - the quality of water use, operation, rational use of material, technical and energy resources; an increase in the area of reclaimed lands, involved in agriculture; increasing the agricultural yield on reclaimed lands - agricultural technologies, the structure of crop rotations, water regime: irrigation-drainage, fertilization system; ecological component - increase and preservation of soil fertility, prevention of degradation processes, protection of water resources from pollution; improving social indicators by increasing highly skilled job sites and rural incomes.

For the successful implementation of the Program, political and financial support from the state is required and the attraction of private investors for the construction and reconstruction of drainage systems, maintaining a high level of soil fertility, financial management, performing information and consulting work, aimed at convincing agricultural producers of the need to build and maintain drainage systems in a standard state, as well as State stimulation of investments by landowners and land users in the radical improvement of drained areas and the use of resource-saving and ecologically friendly agricultural production technologies.

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