Material and technical base of the agro-industrial complex: trends and prospects on the way of innovation-oriented development

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Abstract. All countries of the world recognize the need for systemic modernization and renewal of the agricultural sector of their country, realizing that this is a solution to the problem of combating hunger, strengthening food independence and state security. The agro-industrial complex of Russia creates its material and technical base in difficult economic, financial, social conditions, in the environment of global challenges and risks, economic sanctions of the EU countries and the USA. Responding to these challenges, modern agricultural production, its material and technical base, must be oriented towards innovative development. There is a close correlation between the level of development of the material base of the industry, an increase in labor productivity in the agricultural sector and the standard of living of the population. The active part of fixed assets is most susceptible to physical and moral wear and tear, which means that its rate is much higher, therefore, in the process of renovation and modernization, this element should be given the closest attention. In the region under study, there is a steady tendency to reduce the active part of non-current assets, which leads to an increase in current costs and a decrease in production efficiency. To study the dynamics of change and measure the parameters and rates of renewal and write-off of equipment in time, it is proposed to apply the "coefficient (indicator) of renewal of equipment and technologies".

1 Introduction

The basis of production is its material and technical base, and new equipment and technologies can significantly increase labor productivity, reduce the cost of production, bring significant profit and a high level of profitability. Technically advanced and highly productive modern fixed assets are designed and capable of providing intensive expanded reproduction. Many, both domestic and foreign, scientific publications are devoted to problems of improving the organization of the material base of production in agriculture. All countries of the world recognize the need for systemic modernization and renewal of the industry. It is argued that the progressive development of the agricultural sector in Iran

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is influenced by such key factors of production as climate change and insufficient capital to increase the production of the industry [1]. Thus, the authors confirm the high level of influence of engineering and technology, stimulating the growth rate of agricultural production. Practical experience and scientific developments of researchers of the Czech Republic [2] indicate that if you do not update and modernize equipment and technologies in time, this can lead to failures in the pace of its restoration and renewal, that will negatively affect the technical condition of machines, technological lines and reliability of their operation. It will lead to an increase in operating costs and negative consequences for production. Based on their research, the authors also recognize the fact that after the upgrade, the number of machines required for production is reduced due to their higher productivity. They also pay attention to the need to upgrade grain harvesters at the end of the 6-year depreciation period. Today the agro-industrial complex of Russia is developing and creating its material and technical base in difficult economic, financial, social conditions, in the environment of global challenges and risks. Along with the negative factors that restrain the development of the agro-industrial complex, there are also positive aspects. First of all, this is understanding at all levels of industry management that there is an urgent need to modernize and update the key sphere of the national economy, both the agricultural sector itself and all its structural elements and links included in the system, in particular, the processing industry. Long-term experience of the country's development shows that the industry is the leader in updating the material and technical base, where, first of all, advanced innovative technologies and the latest technology are concentrated. Therefore, modern agricultural production must keep up with the times, the most technically and technologically advanced branch of the national economy. On the example of the Siberian Federal District, the authors of the work argue that there is a close connection between the level of industrial development in the region and the level of technical and technological development of the agricultural sector, orienting it towards high-tech agricultural production [3]. Some domestic scientists [4] see a solution to the problem sustainable development of rural areas in the technological renewal of the agricultural sector. Many leading domestic researchers [5] recognize the fact of aging and retirement of non-current assets in the country's agricultural sector and a decline in the quality of production potential, seeing the solution to the problem in finding sources of investment resources for the purposes of renovation and modernization of production, with an emphasis on state support for the process of renewal of the industry. In addition, the authors see a close correlation between the development of the material base of the industry with an increase in labor productivity in the agricultural sector and an increase in the well-being of the population. This research confirms the need for continuous improvement and renewal of the material and technical base of the agro-industrial complex, due to which the scale of production and labor productivity increase, the unit cost of production decreases, and, no less important, the competitiveness of domestic products in the foreign market is growing [6-10]. Some Russian scientists recognize in their publications the fact that the country's agro-industrial complex lags behind the leading EU countries and the USA in its technical development, offering a way out of this situation by the active introduction of innovative technologies, program-target and project management, digital and cluster economics, considering them to be key factors of growth in labor productivity in the agricultural sector of the national economy [11]. Assessing the current state of the industry and the high level of competition in the world market, many scientists are inclined to believe that modern agricultural production and, first of all, its material and technical base, should focus on innovative development [12-14]. Nevertheless, examining current relationships and trends in two key industries, one has to admit that the agro-industrial complex lags significantly behind industry in its technical, technological, innovative development, but scientific research shows that agriculture, for example, responds more

actively for investments, innovations, the efficiency of the invested material and monetary costs. So, this means that profit and profitability grow, and the payback period of investments is shortened [15]. All this proves the need of more intensive finance and loans to support the agricultural sector of the national economy in the direction of updating its technical and technological vector. The agro-industrial complex of the country got outdated morally and physically, low-productive material base of the Soviet period and its critical state was aggravated during the period of reforms carried out in the 1990s. Attempts to update the material and technical base at that time led to the fact that a significant part of agricultural machinery was actively written off the balance of agricultural enterprises, sold at the market at scrap prices or sent abroad as scrap metal. In those years, the Government of the Russian Federation focused on modernization and renewal of equipment, legalizing the use of accelerated depreciation, when half of the cost of the purchased equipment was immediately written off to production costs, and the rest was allocated to costs using a linear method of depreciation. At the same time there were also profit tax preferences. This mechanism mainly concerned the newly created and developing small forms of management, since the governing bodies focused on this key direction of the forms of organization of production. The experience of those years showed that there were certain positive moments in the renewal of equipment and technologies, however, this did not make any revolution in modernization. As a result, the industry was left without both outdated and new equipment. Large agricultural enterprises, which were badly in need of updating the material and technical base, disappeared. The further development of the agrarian sector of the economy should have been built on them, since the country's agriculture, with its vast areas and scale of production, should be guided, first of all, by large-scale machine production, provided with modern technologies and highly productive equipment. The solution to this problem in the further development of the agro-industrial complex was focused on leasing, thanks to which it was planned to update the material and technical base of the industry quickly. Unfortunately, the high cost of agricultural leasing for rural producers did not allow solving the problem of modernization in a short time and its implementation lasted for many decades. It was so because there were many middlemen in leasing transactions, as a result of which the cost of leasing increased several times in comparison with the selling price for agricultural machinery, which was sent to the market by the manufacturer. When solving this problem, manufacturers of agricultural machinery began to organize their leasing representations, or work directly, cutting out middlemen. As a result, the leasing price has significantly decreased and today it is one of the most effective ways of technical and technological renewal of the industry.

2 Materials and methods

Several leasing companies operate at the agricultural machinery market now, selling high-performance, high-tech imported and domestic machinery. Many agricultural producers, comparing the price of one and the other equipment, are more eager to purchase domestically produced equipment, because its cost is somewhat lower than its foreign counterparts. Nevertheless, when purchasing it, farmers risk that they will have to pay off the producer, even for domestic counterparts, with a harvest of more than one year. The peculiarity of agricultural production in a country of a huge scale of production and types of agricultural products is that in order to obtain a specific type of product, the industry needs an appropriate system of machines adaptable to the specifics of production. For example, potato production is carried out on the basis of the use of such equipment as tractors, plows, harrows, potato sorting stations, potato harvesters, and other specific equipment. Due to the fact that the agro-industrial complex produces a wide range of agricultural products, the agricultural engineering industry faces the difficult task of creating a system of machines

for the production of various types of agricultural products. Today, the agricultural engineering industry produces modern and competitive high-performance, innovative types of equipment that are distinguished by a high level of comfort, quality, reliability, but at the same time have a high cost. As a rule, large agricultural enterprises solve this problem quite effectively and simply, for example, with the agricultural leasing system, the credit mechanism. Small and medium-sized enterprises of the industry have certain difficulties in obtaining a loan from a bank due to low security or its complete absence. Therefore, such agricultural enterprises manufacture products on outdated, long-worn out, and perhaps even long-decommissioned equipment, which often breaks down, requires intensive capital and current repairs, which, in turn, causes the increase in the cost of products manufactured by agricultural enterprises. Such enterprises become uncompetitive in conditions of highly competitive agricultural market, that leads to their bankruptcy. Nevertheless, the need to update the material and technical base of the industry is based on the prevailing negative trends in its modern development, which are still present in the industry today. The fixed assets of agricultural enterprises are the base of production activity, where the gross national product, national income is created. If one considers the level of a specific agricultural enterprise, then this is a method of producing gross, marketable output and the final financial result - income and profit. Thus, non-current assets are the basis of the material production of the society, the basis of its existence. Simple and extended reproduction is based on functioning of all types and forms of intangible assets. According to the classification, non-current assets are divided into active and passive parts. From the point of view of production, the most significant and functional is the active part of fixed assets, since it is the base and the basis for the production of products. In agriculture it includes machines, equipment, tractors, combines, processing lines, workshops, etc. This part of fixed assets is most susceptible to physical and moral wear and tear, which means that its rate is much higher, therefore, in the process of renewal and modernization, this element should be given the utmost attention. The high level of competition at the domestic and especially the foreign agricultural markets requires high-quality products that meet international standards. Only in this case, such products will be in demand at the market. Therefore, new equipment and production technologies will make it possible to produce highly competitive agricultural products that meet international standards, but it is impossible to do this with the help of hopelessly outdated equipment.

In recent years, Ryazan region has been distinguished by a relatively stable economic situation and focused primarily on the agricultural sector of the economy, producing such important types of agricultural products as grain, potatoes, vegetables, feed, milk, meat, and other products. The availability of fixed assets in the agricultural sector can be estimated at 68,790 million rubles or about 5.5 % of the regional fixed assets in the beginning of 2021. Despite the relatively low share in the total structure of fixed assets, the agricultural sector produces strategically important and highly demanded products at the market. Over these years, the process of updating equipment and technologies in the agricultural sector has intensified somewhat, but nevertheless, the existing pace of its renewal is not satisfactory. Today, the region is undergoing a process of aging of the material and technical base of the agro-industrial complex, which is manifested in a high degree of wear and tear, frequent repairs, orders of spare parts for hopelessly outdated equipment, which reduces the economic efficiency of products manufactured by the industry and profitability. Currently, a negative trend has developed in the region in the provision of agricultural production with modern high-performance equipment, and its number is decreasing. In addition, in recent years, some changes have taken place in the regional structure of agricultural production. For example, the emphasis is on crop growing in the gross and marketable output of the industry. The region is increasing grain production. This trend is explained by the increasing demand in world markets for products, therefore, many agricultural enterprises

are redesigning their activities from the cattle breeding industry to this type of products demanded by the market, therefore, to increase the production of grain products, the region needs new combine harvesters. The study of changes in the number of active fixed assets of the region is presented in Table 1, which shows the dynamics of changes in the number of tractors, grain harvesters, potato harvesters, forage harvesters, beet harvesters, seeders for the period of 2005-2018, shows the change in their number in space and time.

Table 1. Dynamics of change in the number of active fixed assets of the regional agro-industrial complex

Assets	2005	2010	2015	2017	2018	2019	Changes in 2019 to the level of 2005	
							%	%
Tractors, units	6,976	4,376	3,496	3,312	3,197	3,134	44.9	-3,842
Change index	1.00	0.63	0.50	0.47	0.46	0.45	0.45	-0.55
Combine harvesters, units	1,778	1,111	957	875	939	932	52.4	-846
Change index	1.00	0.62	0.53	49.2	0.53	0.52	0.52	-0.48
Potato harvesters, units	122	37	40	41	38	37	30.3	-85
Change index	1.00	0.30	0.33	0.34	0.31	0.30	0.30	-0.70
Forage harvesters, units	524	324	237	211	204	202	38.5	-322
Change index	1.00	0.62	0.45	0.40	0.39	0.39	0.39	-0.61
Beet harvesters, units	106	51	35	28	26	25	23.6	-81
Change index	1.00	0.48	0.33	0.26	0.25	0.24	0.24	-0.76
Planters, units	2,249	1,331	966	828	787	753	33.5	-1,496
Change index	1.00	0.59	0.43	0.37	0.35	0.33	0.33	-0.67

According to the data presented in the table, the region has developed a steady downward trend in the number of active non-current assets, for example, the number of tractors over a 13-year period decreased by 3,842 units or by 55 %, grain harvesters by 846 units or by 48 %, potato harvesters by 85 units or by 70 %, forage harvesters by 322 units or by 61 %, beet harvesters by 81 units or by 76 %, planters by 1,496 units or by 67 %. Thus, there is a rapid reduction in the number for all types of active non-current assets. Tractors, planters, beet and potato harvesters have the highest rates of decommission. These rates are due to the fact that this agricultural machinery has been on the balance of agricultural organizations for many years, but was not in the active phase of operation due to high physical and moral depreciation, and often broke down. There were high costs for capital and current repairs, in addition, it was included in the calculation of property tax, which unreasonably increased payments of agricultural organizations to the budget. Besides many types of decommissioned equipment went to agricultural producers in the perestroika period. They are not characterized by high productivity and are physically and morally obsolete. The current situation is taking on an alarming scale, since with the expansion of production activity, which is inevitable in the modern conditions of the industry development, the region may find itself in a state of material and technical imbalance, when the increasing scale of production will not be provided and supported by a material base, especially a tractor and combine fleet. Forecasts show that the region, having significantly reduced the indicators of the industry's provision with key types of equipment, creates conditions for a decrease in the scale of agricultural production and non-fulfillment of

production plans. An important direction in solving this problem is seen in the acquisition of new equipment with high labor productivity through agricultural leasing. Only in this case it is possible to level the losses of production volumes due to the higher quantitative and qualitative characteristics of the work of the renewed machine and tractor fleet of the region. An important vector for the positive development of this process is that the mechanism for decommission of the old equipment is supported by its renewal, i.e. the acquisition of the new one. The ideal rate of renewal with new equipment should be ahead of the rate of decommissioning the old one. In this case, it is necessary to compare the indicators characterizing the effect of renewal and decommission. The comparison of these parameters makes it possible to identify the prevailing trends and predict future directions and ways of updating equipment and technologies in the industry. Table 2 presents data on the rates and ratio of indicators of renewal of non-current assets in key industries of the region in comparison with the average regional indicators.

Table 2. Indicators of renewal of non-current assets of the region in dynamics for 2015-2019, %

Indicators	2015	2016	2017	2018	2019
Fixed assets of the region, total	7.7	5.5	6.4	6.5	6.2
agriculture, hunting and forestry	11.1	15.8	16.2	15.2	14.1
manufacturing industry	14.8	5.0	5.1	6.5	7.3
mining	7.9	1.4	2.3	2.5	3.2

An analysis of the indicators of renewal of fixed assets in the region as a whole indicates that the renewal process is taking place in all the main branches of material production, but the rates of it are very different. So, the average statistical rate of renewal was -6.46 % in the whole for the region for the five-year period of the study, that cannot be considered satisfactory, since the level of physical and moral deterioration of most non-current assets is very high. But the rate of renewal in the agricultural sector is slightly higher. So, the average annual rate of renewal is -14.48 % in this area of material production. For comparison, the indicators of the rate of renewal of non-current assets have been taken in the manufacturing industry, where the average annual rate of renewal is -7.74 %, and in mining with the average annual rate of renewal equal to -3.46%. When comparing these indicators, it is easy to see that agriculture has the highest rates of renewal of non-current assets. As calculations show, such indicators make possible a complete renewal of equipment for a period of 7 years, while in the manufacturing industry the renewal process will last 13 years and 29 years in mining. Thus, the agricultural sector is ahead in terms of the rate of renewal, as compared with both regional average indicators and indicators of renewal in other industries, that inspires cautious optimism about the prospects for the further development of the industry. To maintain such a positive pace of renewal, the regional government and the regional sectoral ministry must provide serious financial assistance and support to this key area of development, since this industry has high social and political significance in the economy. Given the continuing pace of industry renewal, it is possible that this process will not take too long, which means that according to conservative forecasts one can expect labour productivity growth, an increase in agricultural production, growth of profit and profitability in agriculture within the next 3-5 years.

3 Results and discussion

To study the dynamics of change and measure of indicators and rates of renewal and decommission of equipment over time, it is proposed to apply the "coefficient (indicator) of renewal of equipment and technologies" (C_{ren}), which can be calculated as the ratio of

acquired fixed assets (FA_{acq}) to decommissioned ones (FA_{dec}). This indicator can be calculated both when comparing natural and relative units (Formula 1).

$$C_{ren} = \frac{FA_{acq}}{FA_{dec}}, \quad (1)$$

In this case, to calculate the indicator, the relative values of decommission and renewal were used, comparing them with each other. As a result, if this indicator is more than one, the renewal process is identified and if it is less than one, the aging process prevails over the renewal. The study of the dynamics of changes in this indicator in space and time makes it possible to assess and analyze the current situation in the industry in terms of providing it with new equipment and technologies, predict its further development and develop effective measures aimed at the process of technical and technological renewal and modernization of the agriculture. The study and analysis of ongoing processes in the industry are presented by the data of analytical Table 3, which presents some of the main indicators of the "renewal - decommission" of the active fixed assets of the regional agriculture and the renewal coefficient is calculated.

Table 3. Indicators of renewal / write-off of the active part of fixed assets of the agricultural sector of the region (in % to availability at the end of the year)

Type of machinery	2000	2005	2010	2016	2017	2018
Combine harvesters						
bought	1.4	3.6	4.7	8.5	8.0	8.1
decommissioned	8.9	13.3	4.2	4.8	4.2	4.5
coefficient of renewal	0.15	0.27	1.12	1.66	1.91	1.80
Forage harvesters						
bought	2.9	2.5	0.9	3.8	3.3	3.4
decommissioned	8.9	14.5	5.7	3.3	4.1	4.3
coefficient of renewal	0.32	0.17	0.15	1.15	0.81	0.79
Potato harvesters						
bought	0.4	2.4	-	2.6	4.9	5.1
decommissioned	14.0	17.5	22.2	5.0	13.3	7.3
coefficient of renewal	0.02	0.13	-	0.52	0.37	0.69
Tractors:						
bought	1.6	1.8	2.1	3.5	3.5	3.6
decommissioned	7.6	8.3	4.1	3.3	3.4	3.5
coefficient of renewal	0.21	0.22	0.51	1.06	1.03	1.03

As evidenced by the above indicators of the dynamics of decommission and renewal of the active fixed assets of the industry, until 2010, the processes of decommission of agricultural machinery in the region proceeded very actively. But from the same period there have been certain positive shifts towards the renewal of non-current assets. So, the highest rates of renewal can be traced in the combine fleet, and this primarily concerns combine harvesters, where the rate of renewal is almost twice the decommission rate (the renewal rate in 2018 was 1.8). The reverse processes are observed for forage harvesters and potato harvesters, here more equipment is decommissioned than purchased, the processes of renewal of the tractor fleet are somewhat ahead of the pace of the decommission process. Considering the current trends, it can be concluded that the region is currently and in the future oriented towards the priority development of the crop production industry, as evidenced by the high rates of renewal of the regional combine park.

4 Conclusions

The research results show that in the region there is an active decommission of non-current assets, due to their physical and moral deterioration. The maintenance of optimal proportions between the above processes is due to the ongoing structural shifts towards an increase in the volume of crop production and grain, in particular. Today this product occupies the largest share in the structure of gross and commercial products of the agriculture, but the accelerated rate of reduction of the active fixed assets can lead to irreversible consequences, in particular, the lack of the necessary equipment for harvesting ever-increasing volumes of grain. At the same time, there is also some positive dynamics of increasing the rate of renewal of equipment in the regional agriculture. In order to support the active renewal process, it is important that the rate of renewal of non-current assets outstripped the rate of decommission. Only in this case positive dynamics of development and improvement of the technical and technological base of the agro-industrial complex, the renewal of its active part is possible. Studies show that the rate of technical and technological renewal in the agriculture is slightly higher than the regional average indicators and higher than the ones in other key industries in the region, which allows to conclude that the region is pursuing an active policy of modernizing the industry and in the foreseeable future will create preconditions for a significant renewal of the auto-tractor fleet with new and latest technology, conditions for the growth of agricultural production, labor productivity, reduction of current production costs, growth of profit and profitability in the key area of the national economy.

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