Problems and prospects of technical and technological renovation of the regional agro-industrial complex

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Abstract. Technical and technological renewal of the agricultural sector is the main priority of the national agricultural policy, thanks to which the country will be able to reach food independence and security. The modern material and technical base of the industry in most regions, as well as in the country as a whole, is distinguished by a high degree of physical and moral deterioration. It is impossible to produce agricultural products that meet the requirements of world standards with the help of an outdated material and technical base. Due to low profitability, technical and technological renewal and modernization of the material and technical base of agriculture must rely on solid state financial support. Currently, the industry is deeply dependent on technical provision with imported machines and equipment. The key task of the current agro-industrial complex should be considered its transfer to innovations, digital technologies, and robotization. The industry's orientation towards these areas requires the development of modern methods for assessing the efficiency of using fixed assets, innovations and investments.

1. Introduction
The problems of technical and technological renewal of the agrarian sector of national economies in many countries have been the subject of lively discussions of native and foreign scientists for many years. Indeed, this is a key problem of food independence and security of any state, which is closely linked to investment and innovation processes, robotics and digital technologies. The historical aspect of the role and significance of modernization and technological renewal of the agricultural sector in Chile at the beginning of the 20th century is shown [1] and the author considers the use of tractors as a technological innovation, which made it possible to increase the country's cultivated areas significantly, solve the problem of low land productivity and poor ploughing, and also gave a positive impetus to the economic growth of Chilean agriculture. Problems of innovations were raised in many scientific publications of native and foreign scientists, so, according to studies [2], innovations help to improve the life and work of small and medium-sized farmers, contribute to modernization of agriculture. The authors of the work also contributed to theoretical and practical aspects of the characteristics of innovations, applying qualitative and descriptive analysis, focusing on the concept of an innovation system, which made it possible to carry out a wide range of studies in this direction in detail and comprehensively. Investigating the development of agribusiness in Egypt, the authors [3] believe that the innovative direction of the country's agricultural development is information and communication technologies (ICT), which are manifested in the use of mobile communications in rural areas, precision agriculture, services for the study and analysis of data, allowing managers to
understand and manage business better. Scientists believe that agricultural entrepreneurship is the most important business among a wide variety of their types, which means that the use of ICT in this area is an important condition for the successful development of both the industry and society as a whole, and information and consulting services for rural producers is a subset of the general direction of ICT to promote agricultural development. Evaluation of the effectiveness of ICT use in agriculture is manifested in the fact that on the basis of such technologies the right management decisions are made. The study of the effectiveness of ICT use in a number of countries made it possible to identify the most priority areas for the development of new technologies, to develop recommendations for their application to conditions and peculiarities of the country's agricultural sector. The growth of the population of the Russian Federation, the quality and standard of living, highlight the problem of food independence and security state. Agricultural producers around the world are looking for innovative solutions to increase agricultural production. Stable growth in food prices also requires new innovative solutions to scale up production. Realizing the delicacy of the situation with food security in the world, the authors [4] believe that the key direction of the agro-industrial complex development is innovative technologies that can activate the hidden potentials of the agricultural sector, believing that innovations contribute to the growth of the level of food independence, provide equal and fair access for the population to high-quality food, but the solution of the tasks is possible only relying on state support of the agricultural sector of the economy. One of the directions of the sustainability of the modern agricultural economy, rural areas, is its diversification and technological renewal, which will allow the transition from a monofile model of the economy to a multispectral one [5]. The need for the chosen directions is dictated by the peculiarities of agricultural production, for example, seasonal character, low profitability of production and labour, high current production costs.

2. Materials and Methods
The current stage of development of the agro-industrial complex of the Russian Federation is distinguished by an acute need for updating the existing technical and technological base. For many years, agriculture was in crisis, production was carried out with the help of hopelessly outdated material and technical base, as a result of which, it was inferior in competition to foreign counterparts, the equipment used had a low efficiency factor, technologies were highly costly without stimulating the growth of labour productivity, that led to technical and technological backwardness of the industry. Modern problems of agriculture are shown [6], the author argues that native agricultural production is more dependent on imported equipment, for example, its share in the total number of tractors is 69 %, it is 23 % in grain harvesters and 90 % in machinery and equipment for mechanization of animal husbandry. Native equipment used in the industry is 80 % worn out, the rate of its renewal is 2.5-3.0 % per year, while the standard is 12-15 %. This problem also applies to digitalization of the industry, so, according to the scientist, the intensification of pork production in the Russian Federation, including the use of automated digital technologies for performing production processes, is achieved on the basis of the use of equipment from a foreign manufacturer. The modern stage of the economic development of the industry is characterized by some positive changes towards renovation, modernization and its transfer to innovative development. Nevertheless, this positive process has certain difficulties and is delayed in time, because the development and implementation of this direction require great investments. It is necessary to consolidate efforts of all levels of government and management, to search for mechanisms that stimulate the interest of agricultural producers in updating the material and technical base. Today, the state is guided by this direction of technical renewal, nevertheless, these efforts do not bring the desired results and many industries remain technically backward. Due to the fact that the country has large territories and areas of agricultural land, especially arable land, an orientation towards the development and support of the medium, small-scale sector of the national economy, households is not very promising. It gives a slight increase in the volume of agricultural products, there is an urgent need to support and develop large-scale agricultural production, based on advanced machinery, progressive technologies and innovative
approaches, since they are able to solve the problem of meeting the country's needs for agricultural products, ensuring food independence and state security, bringing competitive products to the world market, providing currency earnings. In recent years, Russia has been increasing the production and export of such an important agricultural crop as grain, therefore, the main direction of technical and technological renewal of the industry concerns, first of all, this area and significant financial resources are invested. At the same time, other equally important areas of the agricultural sector of the national economy develop at a slow pace. Therefore, if one forecasts the situation for the nearest future, then the existing imbalances in terms of modernization and technical re-equipment of the industry can lead to the fact that in the agro-industrial complex there will be a significant imbalance in the level and pace of development of some equally important areas of agricultural production, namely, cattle breeding, potato growing, vegetable growing, which will significantly lag behind grain production in terms of technical, technological and innovative development. Considering this factor, the programs of modernization and technical re-equipment of the regions for which funding is allocated from the budgets of all levels should consider this feature and be guided by forecasts.

3. Results and Discussion

Ryazan region is a mirror image of all the problems that have accumulated in the industry over many decades. The fixed assets of the region are at a critical level of wear and tear, modern attempts and directions of modernization are half measures and cannot fundamentally solve the problem of renewal, the growth of labour productivity in the agricultural sector and improvement of other equally important economic parameters of financial and economic activity. For example, over the six-year period of the study, the annual labour productivity in the agricultural sector grew only by 46%, thus the annual growth was only 7.6%, while in many economically successful European countries this indicator changed several times. It is necessary to formulate key approaches to the strategic development of the industry, since modern challenges and risks, competition at world agricultural markets, strengthening of integration ties between the economies of many countries put forward high requirements for the organization of the material and technical base of the industry. Using an outdated basis, it is not possible to produce high-quality agricultural products that are in demand by the consumer, capable of competing both at the domestic and foreign markets. The experience of advanced economies in a number of countries shows that modern science, high technologies, and innovations contribute to the growth of agricultural efficiency, growth of profits, profitability, financial solvency, reduction of current and capital expenditures, and the stability of the industry to external and internal unfavourable factors. To confirm the stated provisions, Table 1 presents a comparative characteristic of the level of depreciation of fixed assets in the region and in the agriculture.

**Table 1.** Comparative assessment of indicators of the level of wear of fixed assets of the region.

| Parameter                                      | 2015   | 2016   | 2017   | 2018   | Deviation of 2018 to 2015, % |
|------------------------------------------------|--------|--------|--------|--------|-----------------------------|
| For the region as a whole (fixed assets), %    | 53.1   | 57.2   | 58.8   | 60.6   | +7.5                        |
| including agro-industrial complex, total       | 33.2   | 35.4   | 36.6   | 37.4   | +4.2                        |
| of which: buildings                            | 12.3   | 16.6   | 17.4   | 18.9   | +6.6                        |
| constructions                                  | 18.4   | 21.7   | 22.4   | 23.6   | +5.2                        |
| equipment, machines                            | 58.3   | 57.4   | 56.4   | 56.8   | -1.5                        |
| vehicles                                       | 53.3   | 48.6   | 47.1   | 46.9   | -6.4                        |

A stable trend has developed in the region, demonstrating the aging process of fixed assets, for example, the wear of fixed assets in 2018 amounted to 60.6%, which confirmed the level of their critical condition, more than half of the machinery and equipment in the sphere of material production were outdated. At the same time, the level of wear in the agro-industrial complex was somewhat lower, but the negative trend associated with the process of physical and moral aging of fixed assets remained. The level of wear of the active part of the fixed assets of the industry, playing the key role
in the production process was especially high (machines, tractors, combines, vehicles, transmission devices and mechanisms). The operation of outdated equipment leads to an increase in operating costs, production costs, a decrease in profits and profitability. The negative effect is intensified by the factor of ever-increasing costs for current and major repairs of constantly breaking and unusable equipment. In order to assess the current state of the material and technical base of the industry more objectively, it is important to pay attention to the study of the indicators of renewal and aging of technology, their dynamics over time. For example, the annual rate of renewal of the active part of fixed assets in the region is 0.6 %, i.e. in ten to fifteen years they will be renewed by only 6-9 %, respectively, i.e. the renovation process will drag on for many decades. Modernization and renovation must develop at a faster pace, otherwise technological backwardness will lead to a loss of competitiveness, markets for products and other negative consequences.

High prices for modern agricultural machinery force regional agricultural producers, in order to save money, to use the old and worn out one, and post it to their balance sheets, which leads to the illusion of an increase in the value and stability of assets. The write-off and liquidation of such equipment can solve the accounting aspect of this problem, that, in turn, will improve the indicators of the balance sheet of agricultural enterprises, and as a result, will contribute to an objective assessment of a number of economic parameters associated with the efficiency of the operation of fixed assets. The modern state policy in the field of modernization and renewal of the industry is based on principles guiding agricultural producers to purchase, although expensive (1.5-2 times more expensive than domestic counterparts), high-performance foreign equipment, characterized by comfortable working conditions, many times exceeding the productivity of the old one, although the payback of such equipment is high, nevertheless, differing in qualitative and quantitative characteristics at full capacity, the absence of large expenses for capital and current repairs, such equipment can pay off in a relatively short service life. Key parameters for assessing the efficiency of using fixed assets are indicators of capital productivity and capital intensity. The first one assesses the level of agricultural production per unit of the average annual value of fixed assets and the second one has an inverse relationship with the first indicator and its economic essence is manifested in fixing the value of fixed assets in the unit of products produced by the industry. The dynamics of changes in the parameters of capital intensity and capital productivity of the region is shown in Table 2.

**Table 2.** Regional assessment of the economic efficiency of using fixed assets.

| Parameter                                      | 2015    | 2016    | 2017    | 2018    | Deviation of 2018 to 2015, (rubles) |
|------------------------------------------------|---------|---------|---------|---------|-----------------------------------|
| Gross agricultural production of the region, million rubles | 52,293.1 | 52,635.3 | 57,157.3 | 51,587.9 | -705.2                           |
| The cost of fixed assets of the agro-industrial complex (average annual), million rubles | 38,661.4 | 49,706.5 | 52,693.4 | 54,126.8 | +15,465.4                       |
| Gross agricultural output per unit of value of fixed assets (capital productivity), rubles | 1.30 | 1.10 | 1.09 | 0.90 | -0.4                            |
| The cost of fixed assets per unit of the cost of gross output (capital intensity), rubles | 0.70 | 0.90 | 0.90 | 1.10 | +0.4                            |

The efficiency of using fixed assets is decreasing in the industry, the capital productivity ratio fell by 0.4 p.p. or 31 % and the capital intensity increased by 0.4 p.p. or 57.1 %. The negative dynamics of the above parameters is evidence that the fixed assets of the region are used ineffectively, the growth in their cost is not paid off by the output. At the same time, there is a reduction in production volumes, which is a factor that also reduces the efficiency of using fixed assets. In recent years, the region has been actively building up and expanding the material and technical base of the industry, in particular, acquiring new equipment and technologies, taking a course towards the phased introduction of
innovations, promoting the introduction of digital technologies, realizing that the future of agriculture lies in the plane of focusing on achievements of scientific and technical progress. The experience of leading foreign and domestic producers of agricultural products has been studied. This policy has led to the fact that in recent years, the average annual cost of fixed assets of the region has grown by 40% or 15,465.4 million rubles, i.e. the average annual increase in the value of fixed assets amounted to 3,866.2 million rubles, but for the same period there was no increase in the value of gross agricultural output, which decreased by 705.2 million rubles. The reason for this was that enterprises purchased cars, tractors, combines, technological lines, which were not brought to full production capacity, were underutilized due to a decrease in production volumes. Thus, significant investments in the industry in recent years have been ineffective due to the prolongation of the problems of previous years, when the industry's products were produced on outdated equipment. Forecasts show that over some time (usually 2-3 years), the economic effect of the introduction of new equipment and technologies into production will take effect, the region will reach the programmed parameters of sustainable growth in gross agricultural production, as a result of which the capital productivity will increase, and the capital intensity will decrease. Nevertheless, predicting in the future a positive growth in gross production volumes, it is necessary to find out the reasons for the decrease in the efficiency indicators of using fixed assets and to determine the numerical values of both negative and positive factors. For this, analytical decomposition of key indicator “capital productivity” into factors is applied.

Table 3. Factor analysis of capital productivity.

| Parameter                                                                 | 2016   | 2018    | Changes for the period, (+/-) |
|---------------------------------------------------------------------------|--------|--------|-------------------------------|
| Gross agricultural production of the region, million rubles               | 52,635.3 | 51,587.9 | -705.2                       |
| The cost of fixed assets of the agro-industrial complex (average annual), million rubles | 49,706.5 | 54,126.8 | +15,465.4                    |
| Capital productivity of the regional agro-industrial complex, rubles      | 1.10   | 0.90   | -0.2                          |
| Conventional indicator "conditional capital productivity in the agricultural sector of the region", rubles | -0.13  | 0.97   |                               |
| Determination of the degree of influence of factor “cost of fixed assets of the agro-industrial complex (average annual), rubles | -0.07  |        |                               |
| Determination of the degree of influence of factor "gross agricultural production of the region", rubles | -0.13 + (-0.07) = -0.2 (Compliant) |        |                               |

The analytical decomposition of "capital productivity" indicator allows to understand in detail the reasons for the decrease in the efficiency of fixed assets of the industry. Calculations show that both factors have had a negative impact on the studied parameter. The growth in the average annual value of fixed assets and their ineffective use led to a decrease in capital productivity by 0.13 rubles and a decrease in the production of gross agricultural products contributed to a decrease in this indicator by 0.07 rubles. Together, both factors contributed to a decrease in capital productivity by 0.2 rubles. (0.13 + 0.07). Moreover, the negative effect of the growth in the average annual cost of fixed assets turned out to be much greater than from the reduction in gross production. To stabilize and bring the efficiency of using fixed assets (capital productivity, capital intensity) to a positive trend, it may be necessary to suspend the process of updating fixed assets for some time. It will make possible to develop ways and methods for effective use of new, available in the region equipment and technologies and make every effort to increase production in growing agricultural crops, improving the farming system, applying digital technologies and innovative methods of raising the livestock, keeping and milking a dairy herd, and to determine the ways of full loading of fixed assets during their
operation, taking into account the risk that the growth rate of the average annual cost of fixed assets will be significantly higher, than the growth rate of gross agricultural output, as a result of which the efficiency of using fixed assets in the industry as a whole will decrease. As a matter of priority, it is important to solve organizational issues related to the development of effective methods for the use and operation of fixed assets that have already been put into operation, which, in the foreseeable future should improve the efficiency indicators of using fixed assets, create the necessary and sufficient conditions for bringing the region to the positive dynamics of main economic growth parameters.

Technical and technological renewal of the fixed assets of the industry is based, first of all, on modern innovative equipment and technologies, which must compete with foreign counterparts, and sometimes be better than them. Thanks to this, the products of the industry will be competitive and will take their rightful place both at the domestic and foreign markets. Unfortunately, today innovations in the sphere of the agro-industrial complex are progressing very slowly. Buying new high-performance and innovative equipment faces a number of difficulties. First of all, this is due to the low profitability of the agricultural sector of the national economy, with a low profitability of production, the income received sometimes cannot provide not only expanded, but also simple reproduction. Scientific research reveals a direct relationship between reproduction and innovation processes, confirming that innovations ensure the reproduction of labour resources, contribute to the growth of soil fertility, improve the structure of fixed and working capital, create a fundamentally new technical and technological base, which subsequently manifests itself in the growth of labour productivity. In the innovation and investment process of the agro-industrial complex, a special role is given to state support. Financial resources directed today to the industry from the federal budget for modernization, renewal, innovation, digital technologies will pay off in the nearest future and create conditions for food independence and state security. This is evidenced by the results of generalization of foreign experience in regulating the investment activities of agricultural producers. So, the USA, Canada, the EU, China, Japan apply the concept of ensuring the most favoured conditions for representatives of the agricultural sector based on benefits and preferences to investors. Nevertheless, many countries also face certain difficulties in the investment process. Researching the experience of large and small farms in the Czech Republic, scientists believe [7] that economically strong farms have more financial opportunities to update the material and technical base through the acquisition of new equipment, technologies and innovation, which means there are more chances for its intensive use. At the same time, many farmers are experiencing financial difficulties. Using the example of their country, the researchers proved the need for state support for the introduction of machine innovations into agriculture, since it is thanks to this support that the equipment is updated at a higher rate, as a result, the number of machines involved in the production process is significantly reduced due to the high productivity and efficiency of new ones.

Although the Russian Federation provides some financial support to the industry in terms of its technical renewal, its own sources of innovation and investment activity are the key ones. For example, in 2018, the organizations’ own funds amounted to 60.2 % and attracted sources were 39.8 %, among which 16.5 % were budgetary, including 2.0 % from the federal budget. The participation of the state in investment and innovation processes is also manifested indirectly through the provision of funds to compensate for interest rates on loans. However, the objective situation is such that the technical and technological renewal of the industry is taking place in a difficult situation, due to the own resources of agricultural producers, not many of them are able to withstand competition and investment strategy. At the highest levels of power and government of the country there is an understanding that innovation, robotization, digital technologies, technical and technological renewal of the industry are an objective necessity aimed at improving the material and technical base of agriculture, increasing its competitiveness, but as studies show [8], the complexity and inconsistency of such processes is partially explained by the lack of proper understanding of the need to support and develop such processes. The inertia of the management staff at the level of agricultural organizations does not allow to promote innovations and digital technologies in the industry. The experience of foreign countries with advanced economies suggests that innovations, digital technologies and
Robotization of the industry are key factors in creating breakthrough technologies in agriculture that can give an impetus to the growth of economic efficiency of production, provide the industry with its own financial resources in the required size and create a reliable material and technical base for increasing the volume of agricultural production. The experience of many countries shows that at the initial stage of the development of innovative processes, priority should be given to technological innovations, which are more closely related to the processes of technical and technological renewal. The importance of supporting technological innovations is reflected in [9], where it is proved by the example of the development of agriculture in India, that technological innovations aimed at mechanization, the transfer of scientific knowledge to farmers and the renewal of fixed assets should be included as an integral element in the technology of agricultural crops cultivation. Innovation is the foundation of sustainable agriculture if it is focused on agroforestry, crop rotation and environmental safety. Another positive aspect of technological innovations is seen by the scientist in improving the soil conditions for cultivation of crops, irrigation and introduction of synthetic fertilizers, which have a prolonged economic effect and are aimed at increasing agricultural production. But such a result can be achieved only if the above measures consider the characteristics of the soil and are balanced. Based on his research, the scientist recommends large-scale investments in the industry in order to maintain a stable trend in the development of agriculture over a long time period.

Innovations should be highly effective, the costs spent on their development and implementation should bring the programmed profit, and innovative products should be in demand both at the domestic and foreign markets. It is believed that when assessing the effectiveness of innovation, one should be guided by the approaches that have developed over the years to methods for assessing the return on investment costs, namely, it is advisable to assess and measure the costs of innovation with the release of innovative products [10]. In this case, it is necessary to calculate an indicator characterizing profitability of the innovation process and the higher it is, the more effective the costs of innovation activity are. It is believed that one should adhere to this approach to assessing the effectiveness in the sphere of material production, including agriculture. This parameter allows a high degree of reliability to assess the level of costs for innovation, to orient agricultural producers to optimize innovation costs, if necessary, which ultimately allows to evaluate innovation through indicators of profit and profitability. It is also subject to analytical decomposition, i.e. determining the influence of a complex of factors on the result, which, in turn, allows to identify contradictions and "bottlenecks" of the innovation process in order to develop techniques, methods and priority directions for increasing the efficiency of innovation, creates conditions for choosing the right guidelines for further development of innovation in the foreseeable future. Table 4 provides an analytical assessment of the effectiveness (profitability) of innovative project in the regional agro-industrial complex.

**Table 4. Analytical assessment of the level of profitability of an innovative project.**

| Parameter | 2017 | 2018 | Changes of the parameter, (+/-) |
|-----------|------|------|-------------------------------|
| Current and capital expenses spent on the creation and organization of an innovative project, million rubles | 1,878.8 | 2,987.0 | +1,108.2 |
| Profit received as a result of the implementation of an innovative project, million rubles | 302.6 | 632.7 | +330.1 |
| The level of profitability of an innovative project, % | 16.1 | 21.1 | +5.0 |
| Parameter of conditional profitability of an innovative project, % | 33.6 | | |
| Influence on the level of profitability of an innovative project, factors: | | | |
| 1) "profit received as a result of an innovative project", % | | +17.5 |
| 2) "current and capital expenses spent on the creation and organization of an innovative project", % | | -12.5 |
| Deviation ID | | +17.5 + (12.5) = +5.0 (Compliant) |
The presented calculations for assessing the effectiveness of an innovative project and factors affecting it allow to conclude that the increase in current and capital costs for its implementation and development is paid off by an increase in profit. So, according to the calculation, the profit factor positively influenced the profitability of the project (degree of influence +17.5 %), while the increase in current and capital costs over time reduced profitability by 12.5 %. Nevertheless, the growth rate of profit from innovative activity is slightly ahead of the growth rate of costs for an innovative project, so the project can be considered conditionally effective. Since the innovation effect remains at a low level, it is necessary to study in detail the structure, size and dynamics of current and capital costs in space and time, identify "gaps" in innovation, bring costs into line with the level of economic effect, and possibly temporarily suspend the process of active investments in order to find and develop key areas focused on cost optimization. Given the fact that the Russian Federation has faced the economic sanctions of the EU and the United States, which led to depreciation of the national currency and increased inflation, it is important to consider the time value of the national currency when assessing the effectiveness of innovative projects, which, of course, will make it possible to conduct research on the effectiveness of innovations with a greater degree of reliability.

4. Conclusion
The high degree of wear of the fixed assets of the agro-industrial complex serves as a brake of its further progressive development. The fixed assets of the industry are used inefficiently and parameters of their efficiency are decreasing every year. It is advisable to assess the efficiency of using fixed assets based on parameters of capital productivity and capital intensity. It should be recognized that there is an urgent need for substantial financial support from the state for the technical and technological renewal of the industry. Innovative projects, due to their relevance, novelty and eccentricity, as a rule, should bring high incomes for organizations that implement them, in order to cover the costs incurred by them. The agricultural sector should be focused on high performance indicators. It is important for managers of enterprises to understand the need for production activities focused on the innovation vector of present and future development. The assessment of the effectiveness of innovations should be based on comparing the output of innovative products with the costs incurred on innovations. The growth of profitability of innovation should be considered a criterion. The current innovative processes in the agricultural sector can be described as contradictory, not meeting the interests and needs of the regions. The state is called upon to create comfortable conditions for enterprises to activate innovation activity. It is believed that only direct financial state support for the innovative development of the industry, the introduction of digital technologies and robotization, is able to bring it to the forefront of technical and technological development, ensure competitiveness at the international level, and neutralize the consequences of the instability of the economic situation and the presence of various types of risks and challenges.

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