Research of trends in the market of secondary use of agricultural machinery in the agro-industrial complex of the Russian Federation

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Abstract. The paper presents the features of solving the most important practical problem for the agro-industrial complex: the development of a system of criteria and indicators for the formation and development of the secondary market of used agricultural machinery in order to optimize the machine and tractor fleet. An assessment of the possibility of using restored (modernized) agricultural machinery has been carried out. Convincing scientific reasoning for the development of this most important area in the activities of the agro-industrial complex makes it possible to constantly improve work to extend the service life of expensive agricultural equipment and the efficiency of its use, including used ones.

1. Introduction
In a large number of countries with developed agricultural production, about 50% of mechanized work is performed by machines that have completed their depreciation period. For example, in the European market for agricultural machinery, there are 3-4 used tractors for one new tractor. The most important reserve for maintaining the technical potential of agricultural producers, and in general the machine and tractor fleet (MTF) of the agro-industrial complex (AIC), is the modernization (restoration) of depreciated agricultural machinery. According to the National Association of Tractor Dealers, there are more than 500 end-of-life equipment remanufacturers in the United States. The main base for the repair (restoration) of agricultural machinery (AM) is a network of repair, technical and service enterprises, which, even in modern conditions, can be a powerful production potential of the agro-industrial complex of the Russian Federation. The enterprises actually operating in the repair and maintenance base of the agro-industrial complex (about 500) need modernization in terms of providing them with modern repair and technological equipment, up-to-date scientific and technical documentation and trained qualified personnel. The solution of these problems will make it possible to replenish the MTF of the agro-industrial complex of the Russian Federation by supplying restored (modernized) equipment according to the forecast data of research institutes in the next 3-4 years for tractors about 50 thousand units, for grain harvesters - 11 .. 12 thousand units, for forage harvesting - 3 .. 3.5 thousand units. The geography of development of the secondary market on the map of the Russian agro-industrial complex is constantly expanding. In more than 30 regions of the Russian Federation, this work has acquired a permanent
character, the process of its improvement is underway, taking into account the use of the most modern technical means and equipment [1, 2].

2. Description of the object of research

The acquired theoretical and methodological potential is the basis for further research in this area. However, the analysis showed the lack of elaboration of the methods of influence of the main indicators and criteria that ensure the formation of the secondary market, based on national interests and priorities in the field of technical support of agricultural production. Also, the urgent task of involving agricultural producers in the system of trade and repair and service business was not considered in order to diversify their activities, increase income levels and create new jobs. It is also necessary to adjust the system of depreciation deductions, which is a potentially effective tool to stimulate the use of agricultural enterprises of their own investment resources for restructuring MTF. In addition, there are no scientifically based recommendations on the regulation of agricultural machinery imports. In this regard, in the modern concept of the development of the domestic market for agricultural machinery, the main organizational and economic provisions that form the secondary market for used machinery should be noted:

- the need for radical changes in the structure of the agro-industrial complex in the interests of agricultural producers to form an effective market environment that would accelerate the implementation of the secondary market for machinery in the agro-industrial complex;
- determination of general organizational and economic indicators affecting the activity of the secondary market formation;
- the role of government participation in the development of a mechanism for state support in the formation of the secondary market of the agro-industrial complex;
- development of an economic mechanism that characterizes the effectiveness of modernization of the existing market;
- formation of information sources for the implementation of innovation policy in the organization of the secondary market used machinery (SMUM).

The materials presented in the work reflect the features and trends of SMUM, possible options for working in the secondary market, where agricultural producers are divided into 3-4 groups, taking into account their financial situation (highly profitable, profitable, unprofitable and marginal enterprises).

To achieve high economic indicators profitable and highly profitable farms are constantly working on technical re-equipment, selling agricultural machinery until the end of its amortization period at fairly high prices, which allows them to reduce the cost of modernization. The average level of profitability of the economy can acquire this technique through the SMUM [3].

It should be noted that in the period from 2005 to 2020, a serious problem arose in the Russian agro-industrial complex with the restoration of imported equipment, which was purchased by Russian consumers during the period under review in the amount of about 75 thousand units. Most of these expensive cars are below the depreciation line. The solution to this issue is more complicated, since the share of working capital in the price of restored imported equipment can exceed 100% (meaning the purchase of imported spare parts, components and assemblies) [4].

It is obvious that the formation of an efficiently functioning SMUM, maintaining the energy parameters of the existing fleet of machines and carrying out work on the modernization of equipment, can become one of the leading tasks of the engineering service of the agro-industrial complex [5, 6]. The economic feasibility of these measures is obvious: the cost of modernized equipment entering the market is within 50 ... 60% of the cost of new equipment, and the amortization period is 85 ... 90% of new machines. In this regard, in such a market are interested, first of all, agricultural enterprises of the average and below the average level of economic condition.
According to research institutes, the machine and tractor fleet of the agro-industrial complex of the Russian Federation is understaffed with the most demanded agricultural machinery by 35-40%, therefore, the restored machinery in the domestic market will find real demand [7, 8].

A survey conducted in more than 20 regional agricultural complexes showed that the majority of farms (about 60%) are focused on purchasing equipment from the secondary market on the condition of its technical readiness not less than 90% of the new one and the cost of not more than 60-65% of the cost of the new one (figure 1).

![Figure 1](image_url)

**Figure 1.** The dependence of the number of buyers on the cost of a used car.

The accumulated experience allows us to determine the main features of the formation of the SMUM in a particular region:

- selection of such types and brands of agricultural machinery that will definitely find demand in the secondary market;
- study and analysis of the market of remanufactured machines and units;
- choice of various sales schemes (direct sales, wholesale, leasing, including preferential, short-term or long-term lease, etc. of secondary market products);
- implementation of long-term relationships with repair plants and base plants for the supply of remanufactured parts and assemblies.

In the formation of the SMUM, one of the main tools is the organization of reliable partnership relations of all its participants. Figure 2 shows a schematic diagram of the interaction of SMUM participants at the regional level.

The developed system of criteria and indicators of the secondary market will allow the buyer to accurately determine the main parameters of the purchased car and give an objective assessment based on them.

The rise in prices for new cars determines the economic feasibility of repairing and using restored equipment. Thus, research by specialists has shown that the funds spent on the purchase of one new tractor can be used to repair 4-5 used tractors. This conclusion is confirmed by the experience of foreign countries with developed agricultural production [9].

During 2017-2020 research institutes have prepared a number of proposals for individual regions of the agro-industrial complex of Russia to create a market for used (modernized) agricultural machinery with the development of criteria and indicators characterizing the efficiency of its work.
The developed system of criteria and indicators of the secondary market will allow:

- prepare working projects for the formation and development of the secondary market in the constituent entities of the Russian Federation, large agricultural enterprises with justification of the feasibility of creating a system of organizational and economic use of used agricultural machinery;
- effectively select the range of energy-rich equipment for use in the secondary market;
- determine the residual value of used equipment;
- have reasonable requirements characterizing the technical condition of used equipment with an assessment of the possibility of using it in the secondary market;
- effectively use the technological regulations for the sale of reconditioned used agricultural equipment with the purpose of strengthening the technical base of economically weak and medium-sized farms in the agro-industrial complex;
- to prepare working projects for the creation of sites for the concentration of spare parts with decommissioned equipment suitable for reuse in the restoration or modernization of complex equipment.

The development of SMUM in the agro-industrial complex of Russia can become an effective measure for a more complete and economically profitable provision of rural commodity producers with the necessary resources.

The main participants will be federal and regional management structures of the agro-industrial complex, manufacturing plants, repair enterprises, research institutes, banking structures, supply and commercial organizations, holdings, agricultural enterprises of various forms of ownership.
3. Research results and their analysis
Given the current level of supplies of domestic agricultural machinery by 2023, the provision of agricultural producers with the main energy-intensive machinery (tractors and combines) will come to a critical level, since in the structure of the MTP of the Russian agro-industrial complex more than 70% is occupied by machinery exceeding the amortization period by 2 or more times.

Currently, there is no single information field reflecting the state and movement of used agricultural machinery and equipment, of which there are more than 200 thousand units in the agro-industrial complex of the country.

The purpose of creating a SMUM is to unite on the scale of the Russian agro-industrial complex information related to the organization and regulation of the supply of modernized equipment, components, assemblies and spare parts. Using this structural mechanism, agricultural producers have the opportunity to simplify the procedure for searching for potential suppliers and consumers of agricultural machinery, as well as to form real prices for used resources and provide guarantees for the execution of transactions to the participants of the SMUM. SMUM, organized on the scale of the agro-industrial complex of Russia and equipped with modern electronic communication means, will be a reliable source of obtaining the necessary resources for most agricultural producers, repair enterprises and manufacturing plants [10, 11, 12].

The novelty of the research is the development of the SMUM project, which can be implemented both at the federal and regional levels. This project has scientifically based parameters and criteria in a market economy.

4. Conclusions
Formation and implementation of SMUM is a key direction of improving the technical equipment of agricultural producers, which will allow to accelerate renewal at a faster pace, improve the quantitative and qualitative composition of the agro-industrial complex machine and tractor fleet and save significant amounts of their financial resources by purchasing equipment on SMUM.

The developed system of criteria and indicators for the development of the secondary market for used equipment in the conditions of its real functioning will certainly make it possible to conduct a comprehensive technical and economic analysis of the feasibility of creating a SMUM in one or another constituent entity of the Russian Federation, that is, the economic efficiency of the restoration and modernization of energy-rich equipment is substantiated with the subsequent development of schemes and channels of its promotion through the mechanism of the secondary market to the agricultural consumer.

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