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Conference on Land Economy and Rural Studies Essentials**JUSTIFICATION OF OPTIMAL MATERIAL AND TECHNICAL  
STRUCTURE OF AGRICULTURAL ENTERPRISE**

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**Abstract**

The state of an agricultural enterprise's material and technical base must correspond to modern achievements in the field of scientific and technological progress. High-quality production resources will provide the population with healthy and environmentally friendly food products and the industry with high-quality raw materials. Thus, this orientation of production towards improving the quality of products will increase the level of consumption of domestically produced agricultural products, ensure the country's food security, and contribute to the development of rural areas. The state, implementing federal and regional programs for the development of agriculture, pays special attention to the modernization of the material and technical base, technical re-equipment, and reconstruction of agricultural production. Reproduction of the property complex of an agricultural enterprise is becoming a significant task implemented within the framework of the state policy for the development of agricultural markets. Along with this, some problems restrain the reproduction processes of an agricultural enterprise's material and technical base, associated with insufficient provision of agricultural organizations with domestic technology and equipment and the lag of domestic technologies from foreign ones in some areas. Restraint in the development of the technical potential of the industry is due to a lack of financial resources, a low level of cooperation and integration of agricultural producers, insufficient development of the infrastructure of service centers.

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*Keywords:* Agricultural enterprise, material and technical base, optimal parameters, structure



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## 1. Introduction

The material and technical base of agricultural production is a set of means and objects of labor formed in the process of purposeful human activity by transforming material resources. The transformative activity is based on the achievements of science and technology in the field of agriculture. It is the development of science and technology aimed at implementing the continuous production of high-quality and competitive agricultural products. Such products make it possible to meet the needs of the population and the processing industry to ensure an agricultural enterprise's high level of profitability (Wengle, 2021).

The modern material and technical base of an agricultural enterprise directly depends on the level of financial support. An agricultural enterprise's modern material and technical base is a set of interrelated elements united by production technology. On this basis, we can conclude that the efficiency of using the material and technical base depends on the efficiency of using each element at all levels of the production process. Financial independence of agricultural production can be achieved only through the rational use of all resources at the organization's disposal. Digitalization of production, the state policy of import substitution, sanctions pressure from Western states requires modern agricultural production to take into account all the existing features of the use and reproduction of the material and technical base of agricultural production (Amirova et al., 2020; Tarasenko et al., 2020). Taking these features into account will effectively respond to external and internal factors and make management decisions in changing market conditions.

## 2. Problem Statement

Based on a comprehensive study of literary sources, domestic and foreign authors, the following features of the reproduction of the material and technical base of agricultural organizations were identified and allocated into separate groups (Kulikova et al., 2018):

Agricultural land and animals are an integral part of an agricultural enterprise's material and technical base. Fixed and circulating assets should be used taking into account soil fertility, biological characteristics of plants and animals;

- agricultural organizations carry out their activities in various natural and climatic zones; therefore, in the production process, the peculiarities of these zones should be taken into account in order to form and use the optimal structure of the material and technical base;

- agricultural production is seasonal, as a result of which part of the material and technical base in specific periods is not used, which entails additional costs for its storage;

- modern equipment and machines are complex devices with integrated elements of digital control and navigation, the use of which requires highly qualified employees;

- the formation of the material and technical base is carried out taking into account the specialization of the agricultural enterprise and the needs of the market;

- modern agricultural production should be carried out using innovative and high-performance technology, which will allow producers to compete with foreign suppliers of agricultural products, thereby ensuring a high level of import substitution and development of rural areas;

- the reproduction of the material and technical base should be carried out through the integration of agricultural producers by combining financial, material, and labor resources, attracting additional investments in the development of material and technical means of production.

The described features should be taken into account in forming the material and technical base of an agricultural enterprise, developing management decisions aimed at increasing the volume and quality of agricultural products.

### **3. Research Questions**

The efficiency of agricultural production directly depends on the availability and level of development of the material and technical base, the level of production use, and technical potential. Fixed assets are central to the production process. Over the period from 2015 to 2019, the cost of fixed assets of agricultural organizations at the beginning of the year increased from 94.3 to 157.1 billion rubles, or by 66.6%. In the structure of fixed assets, the largest share is occupied by machinery and equipment, vehicles, which increased by 11.1 and 5.7% during the analyzed period, respectively. There is a positive trend towards increasing the renewal rate by an average of 1% annually. However, the level of depreciation for the entire period remains high – more than 42% (Kirillova et al., 2020).

Investments are the basis for forming a suitable material and technical base, which depends on the efficiency of agricultural production. The analysis showed that the Krasnodar Territory occupies a leading position in terms of the level of investment provision among other regions of the Russian Federation. In 2019, the region successfully implemented investment projects in the crop and livestock sectors worth more than 19.9 and 6.5 billion rubles, respectively. Over the period from 2015 to 2019, investments in fixed assets increased by 45.7%, including crop production by 98.8%.

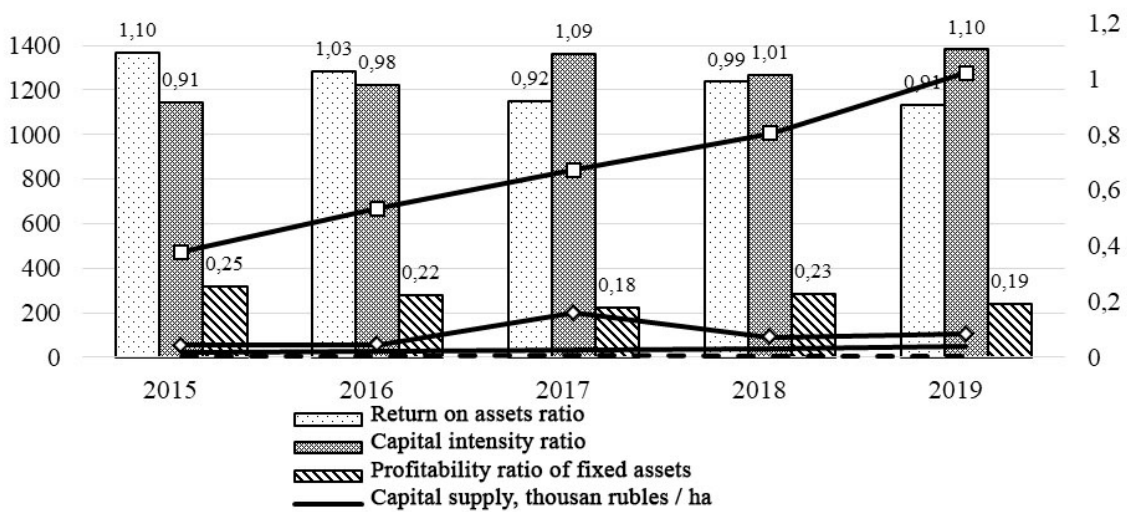
In 2019, manufacturers of the Krasnodar Territory produced over 1.75 thousand units of agricultural machinery and equipment, sold more than 1.5 thousand units. The main incentive for buying the products of local machine builders was the program to support agricultural producers in the Krasnodar Territory, which provides for subsidizing a 10% discount on the price of agricultural machinery for end users. As of 01.01.2020, more than 30 agricultural engineering enterprises operate in the Krasnodar Territory, producing tractors, combine harvesters, tillage equipment, seeders, sprayers, fertilizer spreaders, and irrigation equipment.

For the period from 2015 to 2019, there is a high load on one tractor and combine. There remains a shortage of equipment and modern technologies, and agricultural organizations lack modern high-performance digitalized equipment. Thus, the share of grain harvesters over ten years old is 44%, forage harvesters – 42%, tractors – 58%. It is economically beneficial to use "smart" equipment because its use increases productivity and reduces field operations' labor intensity. This process makes it possible to work in poor visibility, reduces labor costs, fuel consumption, obtains the most accurate measurements, and predicts the problem even before it appears.

A severe problem in providing agricultural production with machinery is high prices (Thomas et al., 2019; Zolkin, Matvienko et al., 2020). On the eve of fieldwork, manufacturers increase the price by at least 10% – 25%, which leads to the termination of previously concluded contracts for equipment supply under leasing and investment agreements. A significant part of agricultural machinery has no domestic

counterparts, for example, low-power tractors, high-performance grain harvesters, accounting for twenty to eighty percent of all imports. In the medium and long term, this significantly reduces the renewal rate of the agricultural machinery fleet, thereby negatively affecting the efficiency of agricultural production. Many researchers are inclined to believe that if the rate of equipment renewal is doubled, the modernization process can take up to eight years. As of 01.01.2020, in the Russian Federation, the shortage of tractors of all types is more than 60 thousand units, and the shortage of grain harvesters is more than 80 thousand units. Every year agricultural enterprises receive about 10 thousand tractors and 5 thousand combines.

During the period under review, there has been an increase in the cost of fixed assets in agricultural organizations of the Krasnodar Territory (Figure 1).



**Figure 1.** Provision of stock and energy resources of agricultural organizations of the Krasnodar Territory

From 2015 to 2019, the capital supply and energy supply increased by 96.4 and 38.4%, respectively, while the capital-labor ratio and power-to-labor ratio increased 2.6 times and by 94.8%. The value of current assets, to the most significant extent, stocks, tend to grow annually.

#### 4. Purpose of the Study

The study aims to develop theoretical and methodological developments aimed at improving the reproduction of the material and technical base and increasing the economic efficiency of using the technological potential of agricultural enterprises.

#### 5. Research Methods

The study was carried out based on materials from the Krasnodar Territory, for which agricultural production is an important sector of the economy. According to the data of the Office of the Federal State

Statistics Service for the Krasnodar Territory and the Republic of Adygea, as of 01.01.2020, 3,654 enterprises and organizations operate in the sector of agriculture, forestry, hunting, fishing, and fish farming. The specific weight of the industry in the structure of the gross regional product is 8.8%. The leading producers of agricultural products are agricultural enterprises; their share in the gross output is more than 62%. The development of agricultural enterprises' production and resource base is a significant task that must be solved to provide the population with high-quality and environmentally friendly food products for its production.

## 6. Findings

In the process of research, in order to determine the optimal structure of the material and technical base of an agricultural enterprise, the methods of economic and mathematical modeling were used, tested at the Department of Economic Cybernetics of the Kuban State Agrarian University.

This study was based on the scenario approach of planning and forecasting an agricultural enterprise's material and technical base, which involves the formation of optimistic, pessimistic, and realistic development scenarios.

Within the framework of the state program of the Krasnodar Territory, "Development of agriculture and regulation of markets for agricultural products, raw materials, and food," the optimistic scenario of development will be fully implemented. The pessimistic scenario envisages crisis conditions for the functioning of an agricultural enterprise, for example, low yields due to unfavorable weather conditions. A realistic scenario assumes creating the conditions necessary for stable growth in agricultural production (Moretti et al., 2021; Zolkin, Faizullin et al., 2020).

In the event of an unforeseen situation arising during the production process or unfavorable market conditions, the resulting scenarios can be used for making management decisions to minimize losses.

Modeling was carried out based on materials from agricultural organizations of the central natural-economic zone. The obtained results of mathematical modeling make it possible to single out optimistic and realistic development scenarios that provide maximum profit sufficient for the implementation of expanded reproduction of the material and technical base (Table 1).

There are minor changes in the structure of fixed assets depending on the development scenario. So, in the optimistic development scenario, the share of buildings and structures decreases by 3%, and the share of machinery and equipment increases by 3%. The structure of the main means of production of an agricultural enterprise is determined by considering the criterion of maximizing profits and calculating the optimal structure of sown areas and livestock of farm animals. Most of the products are sold ready-made. The pessimistic forecast assumes low sales prices; as a result, the model fulfills the conditions for contractual supplies of agricultural products that ensure the maximum effect from the production and sale of products. The structure of assets in the pessimistic forecast corresponds to the general dynamics of the increase in the total value of fixed assets.

**Table 1.** Development scenarios

Index	Actual values, 2019	Development scenario		
		Optimistic	Realistic	Pessimistic
Sown area structure, %:	100,0	100	100	100
Cereals and legumes	21,1	22,9	22,4	23,9
- winter wheat	10,5	11,4	11,1	11,9
- corn for grain	0,9	1,0	1,0	1,0
- oats	1,1	1,2	1,2	1,2
- barley	6,9	7,5	7,3	7,8
Rice	58,3	54,6	56,5	50,0
Oilseeds	0,5	0,6	0,6	0,3
- winter rape	0,5	0,6	0,6	0,3
Fodder crops	20,2	21,9	20,5	25,8
- annual herbs	1,8	1,9	1,8	2,3
- perennial herbs	13,0	14,1	13,2	16,6
- corn for feed	5,4	5,8	5,5	6,9
Livestock of cattle, head	400	484,0	421,0	389,0
including cows	400	484,0	421,0	389,0
Fixed assets cost, million rubles	309,6	356,1	340,3	339,6
Profit, million rubles	84,3	249,3	116,7	533,9
Profitability level, %	17,2	37,1	31,4	4,8

To implement uninterrupted production and sale of agricultural products, the base enterprise needs to carry out a constant renewal of working capital. The study found the following:

- the organization of working capital should include the definition of their structure and composition;
- the size of the required working capital for uninterrupted production;
- determining the sources of their formation; balance and movement of working capital in the production process; identification of persons responsible for their content and practical use.

The constructed mathematical model makes it possible to determine the optimal composition and structure of defense assets, depending on the development scenario (Table 2).

**Table 2.** Demand for working capital

Index	Actual values, 2019		Development scenario					
			Optimistic		Realistic		Pessimistic	
	million rubles	%	million rubles	%	million rubles	%	million rubles	%
Stocks – total	391,9	100	478,1	100	472,5	100	360,4	100
- raw materials, materials and other similar values	104,8	26,7	109,9	23	130,7	27,6	96,8	26,9
- animals for growing and fattening	54,4	13,9	73,7	15,4	77,3	16,4	49,1	13,6
- costs in work in progress	38,6	9,8	38,3	8	46,4	9,8	35,9	10
- finished goods and goods for resale	194,1	49,5	256,2	53,6	218,1	46,2	178,5	49,5
- other supplies and costs	0,1	0,02	0,2	0,04	0,1	0,02	0,1	0,02

The resulting structure of the working capital of the base enterprise makes it possible to single out an increase in the share of working capital in the optimistic scenario. This statement is because the optimistic scenario assumes to use the maximum available production capacity and ensure the maximum volume of agricultural production. The pessimistic development scenario offers a saving trajectory; in this regard, the working capital will decrease due to the full use of the existing reserves of the enterprise to maximize savings in storage, movement, and maintenance.

## 7. Conclusion

The analysis allows concluding that there is a positive trend in the development of the material and technical base, characterized by an increase in the share of renewed fixed assets, an increase in investment in agriculture, an increase in capital and energy security. At the same time, we must admit that a significant increase in the capital supply is mainly due to the rise in prices and is not accompanied by a noticeable increase in inefficiency.

The stated methodological approach to developing optimal parameters of the material and technical base is based on optimization and modeling methods. This methodological approach makes it possible to obtain the multivariate implementation of scenarios and development parameters, the volume of products, the optimal structure of fixed and defense assets, the amount of investment required, and indicators of economic efficiency. Ultimately, this methodological approach will increase the efficiency of using the material and technical base.

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