Economic mechanism of the machine-tractor park updating in the Samara region

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Abstract. The article discusses the situation with the restoration of the machine and tractor fleet of agricultural enterprises in the Samara region and determines the role of individual elements of the economic mechanism. In modern conditions, the main guarantee of the success of agricultural production is the maximum mechanization of production processes. Replacement of manual labor by machine allows reducing the cost of production, increasing its output, implementing modern industrial technologies, reducing the dependence of the result on the human factor. The purpose of this study is to determine the capabilities of agricultural enterprises in the Samara region to modernize the composition of the equipment used. The number of almost all types of energy and agricultural machinery compared with the 1995 level has decreased significantly. At the same time, energy supply per 100 hectares of arable land has stabilized, which is explained by the choice of powerful, productive equipment. The situation can be corrected by increasing the profitability of crop production and correcting the situation with price disparity. Direct government funding for acquisitions has declined. Among the instruments of state support, along with interest rate subsidies, subsidization of expenses for the purchase of cars has been widely used. The amount of subsidies reaches 492.2 million rubles (2013). The applied measures of state support in the conditions of the Samara region are complex and, with prolonged use, can solve the problem of updating equipment.

1. Introduction

In modern conditions, the main guarantee of the success of agricultural production is the maximum mechanization of production processes [1-3]. Replacement of manual labor by machine allows reducing the cost of production, increasing its output, implementing modern industrial technologies, reducing the dependence of the result on the human factor [4-7]. Based on the achievements of modern science and technology, domestic agribusiness can provide leadership in the production of agricultural products [8-10]. However, there are a number of factors that limit the ability of agricultural enterprises to upgrade the machine and tractor fleet. The main one is an increase in price disparity between agricultural and industrial sectors [11-15].

The purpose of this study is to determine the capabilities of agricultural enterprises in the Samara region to modernize the composition of the equipment used. Within its framework, the following tasks are expected to be solved: - to identify the economic characteristics of agricultural enterprises in the
Samara region and the influence of elements of the working environment on them; - to study the effect of price disparity on the process of updating the machine and tractor fleet; - analyze the region’s capabilities to stimulate the acquisition of technology.

2. Materials and Methods
The object of the study was the economic mechanism for the modernization of agricultural production in the region. The research methodology includes the study of the economic features of the acquisition and disposal of fixed assets (agricultural machinery) in the Samara region, as well as the factors that stimulate this process, taking into account the use of modern achievements of science and technology. In the process of conducting the research, historical, monographic, expert, economic and statistical methods were used.

3. Results
The process of equipment updating in the region conditions is characterized by multidirectional trends, which in general terms are characteristic for the entire economy as a whole.

Table 1. The quantitative composition of the main types of equipment at agricultural enterprises of the Samara region, thousand pieces (at the end of the year).

| Name                          | 1995 | 2005 | 2010 | 2015 | 2016 | 2017 |
|-------------------------------|------|------|------|------|------|------|
| Tractors                      | 19.2 | 8.7  | 5.2  | 4.3  | 4.3  | 3.9  |
| Combine harvesters            | 6.6  | 3.1  | 1.6  | 1.4  | 1.4  | 1.3  |
| grain harvesting              | 2.0  | 0.5  | 0.3  | 0.2  | 0.2  | 0.2  |
| forage harvesting             | 0.2  | 0.1  | 0.1  | 0.1  | 0.1  | 0.0  |
| potato harvesting             | 6.9  | 2.5  | 1.2  | 1.2  | 1.2  | 1.2  |
| Machines for tillage          | 8.9  | 4.0  | 2.4  | 2.2  | 2.1  | 2.0  |
| plows                        | 9.8  | 4.6  | 2.9  | 3.1  | 2.0  | 1.8  |
| cultivators                   | 1.8  | 0.6  | 0.4  | 0.3  | 0.4  | 0.4  |
| Seeders and sowing complexes  | 0.4  | 0.2  | 0.3  | 0.4  | 0.4  | 0.4  |
| mowing-machine                | 4.3  | 1.4  | 0.8  | 0.5  | 0.6  | 0.5  |
| Mower feed machines           | 1.7  | 0.3  | 0.3  | 0.3  | 0.3  | 0.2  |
| balers                        | 0.8  | 0.2  | 0.2  | 0.2  | 0.2  | 0.2  |
| Roll headers                  | 0.3  | 0.05 | 0.02 | 0.02 | 0.0  | 0.0  |
| Sprinkling and irrigation     | 0.5  | 0.1  | 0.0  | 0.02 | 0.0  | 0.0  |
| machines and installations    | 0.8  | 0.4  | 0.3  | 0.4  | 0.4  | 0.3  |
| solid mineral fertilizers     |      |      |      |      |      |      |
| solid organic fertilizers     |      |      |      |      |      |      |
| liquid organic fertilizer     |      |      |      |      |      |      |

As shown in Table 1, the number of almost all types of energy and agricultural machinery compared with the 1995 level has significantly decreased. The number of combine harvesters since 2005 decreased by 58.1%, tractors - by 55.2%, forage harvesters - by 60% [16]. At the same time, in the last four years this process has slowed down, and for some positions it has stopped. Simultaneously, the indicator of energy supply per 100 ha of arable land stabilized at a much earlier period, which is explained by the choice of modern, powerful, productive equipment, both domestic and foreign production. This, in turn, reduces the need for the amount of equipment purchased, increases the load standards per unit of equipment [17-18]. Several factors influence the correction of the situation with the provision of agricultural enterprises with equipment. The main one is the increase in the profitability of crop production and the correction of the situation with price disparity in for agricultural and industrial products. If in 2010 the profitability
of crop production sales was 16.5%, then in recent years - 42.5% (2015) and higher. Also, stabilization of the proportions of interbranch exchange is observed, as evidenced by the data in Table 2.

Table 2. The exchange ratio of certain types of crop production and equipment (1 unit of equipment / 1 ton of grain), t.

| Ratio | Years | Change ratio | 2005 | 2012 | 2015 | 2016 | 2017 | 2018 |
|-------|-------|--------------|------|------|------|------|------|------|
|       |       |              | 2005 | 2012 | 2015 | 2016 | 2017 | 2018 |
| Tractor K-744 |         |              |      |      |      |      |      |      |
| wheat | 1150  | 964          | 706  | 779  | 942  | 892  |      |      |
| rye   | 1045  | 1131         | 1011 | 1141 | 1425 | -    |      |      |
| barley| 1095  | 944          | 886  | 769  | 949  | 886  |      |      |
| buckwheat | 460 | 384          | 357  | -    | 542  | -    |      |      |
| sunflower | 383 | 459          | 354  | 279  | 400  | 382  |      |      |
| Tractor K-744 |         |              |      |      |      |      |      |      |
| wheat | 503   | 488          | 366  | -    | -    | -    |      |      |
| rye   | 457   | 572          | 524  | -    | -    | -    |      |      |
| barley| 479   | 478          | 459  | -    | -    | -    |      |      |
| buckwheat | 201 | 194          | 185  | -    | -    | -    |      |      |
| sunflower | 168 | 232          | 184  | -    | -    | -    |      |      |
| Harvester Yenisei-1200 |     |              |      |      |      |      |      |      |
| wheat | 313   | 364          | 288  | 371  | 499  | 486  |      |      |
| rye   | 284   | 427          | 412  | 543  | 754  | -    |      |      |
| barley| 298   | 356          | 366  | 502  | 483  |      |      |      |
| buckwheat | 125 | 145          | 145  | -    | 287  | -    |      |      |
| sunflower | 104 | 173          | 144  | 133  | 212  | 208  |      |      |

Disturbed during the years of transition to market relations, price equivalence between the agribusiness and industry has stabilized in recent years [19-21]. The beginning of market transformations was characterized by explosive growth in prices for industrial products. At the same time, food prices increased significantly more modestly. When analyzing the volume of crop production needed to acquire the main types of equipment, a decrease in exchange proportions is seen in the study period. So for the purchase of 1 tractor K-744, the volume of required grain changed from +36.4% (in the case of winter rye) to -22.4% (for wheat). For harvester Yenisei-1200, the ratio changed from +14.7% (for winter rye) to -27.2% (for wheat). In the study period, the exception was only the truck KAMAZ-4510, in which case there was a further increase in the price gap (the minimum increase was +55.4% in the case of wheat, the maximum - in rye (up to +165.6%)). During the analyzed period, the price imbalance in relation to the main types of products (sunflower, barley, wheat) decreased by more than a quarter. Maintaining significant price disparity in 2016-2018 led to an almost complete exclusion from crop rotation of crops such as winter rye and buckwheat.

As a result, agricultural enterprises and farms got the opportunity to more efficiently update their technical equipment even with further violation of price proportions [22].

There has been an increase in the process of restoring the number of new machines and equipment in recent years. The observed increase across the entire range of agricultural machinery exceeded the data for the study period (with the exception of tractors). First time for the period 1995-2017 it is revealed that less equipment is decommissioned for various reasons than acquired. This characterizes the current situation in agricultural production as having a positive trend. In the study period, the growth rate of the load on 1 tractor decreased compared to the previous ones. At the same time, the increase in load is offset by an increase in the power of acquired tractors. Simultaneously, the load on combines (both corn and potato harvesters) is falling [23].

Currently, the renewal of the equipment fleet in the conditions of the Samara region is carried out at the expense of own funds of agricultural enterprises. According to statistics, they make up from one third to three quarters of the total investment in fixed assets. The second most important source of investment is borrowed funds (mainly from commercial banks). In the process of implementing the National Project "Development of the Agribusiness" after 2006, a number of banking institutions
Sberbank, Russian Agricultural Bank) have developed and implemented special loan products that provide for the possibility of acquisition of machinery and equipment against their collateral. Additionally, part of the interest rate was subsidized from the consolidated budget. The process of obtaining such loans is very time-consuming, but they perform their function.

![Subsidies for the reimbursement of expenses for the purchase of equipment from the regional budget of the Samara region, million rubles.](image)

**Figure 1.** Subsidies for the reimbursement of expenses for the purchase of equipment from the regional budget of the Samara region, million rubles.

Direct financing by the state (both regional and federal budgets) of equipment acquisition decreased almost to zero after 2006. During this period, the practice of concessional budget lending was terminated. In the period 2000-2005 budget investment in order to increase the fixed capital of agricultural enterprises amounted to 15.8-29.0%. In recent years, the share of this type of investment has decreased to 2.6-5.2% due to direct financing of the equipment acquisition of by regional and municipal enterprises.

When updating the machine-tractor fleet of agricultural enterprises, the state not only reimburses costs in the framework of investment lending, but also compensates for part of the cost of purchased machinery and equipment and leasing. This direction of support is funded exclusively within the regional budget. The amounts used for these purposes differed by a wide scatter. In some years, there has been a sharp decrease (49.0 million rubles in 2010, 134.5 million rubles – in 2015), then explosive growth - up to 492.2 million rubles in 2013 or up to 466.8 million rubles - in 2017 (Figure 1).

The rules for receiving, directing and the amount of state support are described by the procedures for providing subsidies, among which there is also the procedure for providing subsidies for the purchase of equipment.

**Table 3.** List of machinery and equipment subsidized in the Samara region.

| Name of equipment                                                                 | Compensated percentage of the equipment cost, % |
|----------------------------------------------------------------------------------|-----------------------------------------------|
| Subsidies for the period 2013-2015                                               |                                               |
| Equipment of Samara production                                                    |                                               |
| Machines and equipment for crop production and livestock raising                  |                                               |
| Tractors with a capacity of over 110 horsepower                                    | 10                                            |
| Tractors with a capacity up to 110 horsepower                                       | 10                                            |
| Harvesting equipment                                                              | 25                                            |
| Equipment produced in the territory of the Russian Federation                     |                                               |

![Table 3](image)
Decisions of the Government of the Samara Region on subsidizing equipment updates formulate the parameters, as well as the requirements put forward by agricultural producers for state support. The main form is the reimbursement of the cost share incurred in the current or past years for the purchase of machinery, equipment and mechanisms. In addition to sales transactions, leasing agreements are also taken into account. The nomenclature of subsidized equipment is periodically changed, subsidy rates are updated, which is also fixed by Decisions of the Government of the region. Change options are illustrated in Table 3.

Subsidizing is carried out on the following conditions:
- the use of agricultural machinery is possible only for agricultural production in the Samara region for at least two years, counting from the period of registration of the subsidy;
- for the purpose of producing varietal seeds (original and elite) in the Samara Region, as well as the first reproduction in two years, counting from the period of the subsidy.

The maximum amount of support in this area that one agricultural producer can receive during the calendar year is 5 million rubles. With significant amounts of costs for the purchase of agricultural machinery within one year (more than 40 million rubles), the total amount of payments can be increased to 10 million rubles.

There are also disadvantages to this type of subsidy. The following points can be attributed to them:
- insufficient amount of financial resources budgeted to provide this type of support (not all enterprises and farmers who buy agricultural machinery receive subsidies);
- exact date of the start of the subsidy is not documented in the relevant Procedure;
- insufficient informational support for the registration process of this type of support (most agricultural producers do not receive information about the start of the allocation of subsidies and, accordingly, may be late with the preparation of documentation);
- allocation of financial resources under this article of subsidies is carried out according to the residual principle (when additional budget revenues are received, the amount of support does not increase, when a deficit of budget funds is manifested, it is reduced first of all).

4. Conclusions
The process of updating the machine and tractor fleet of agricultural enterprises, both in the Samara Region and in the Russian Federation as a whole, faces a number of objective difficulties. Low profitability of agricultural production for a long time, disparity in prices, difficulties with obtaining investment loans - all this negatively affects the size and intensity of the acquisition of new equipment. In these conditions, the role of state support is increasing. The measures used in the conditions of the Samara region are complex and, with prolonged use, can solve the problem.
References

[1] Huang W, Zhou W, Chen J, Chen X 2019 *Omega United Kingdom* 84 pp 70-101
[2] Pan B, Tian Z 2018 *Transactions of the Chinese Society of Agricultural Engineering* 34 9 pp 1-10
[3] Subaeva A, Zamaidinov A 2015 *International Business Management* 9 7 pp 1770-1774
[4] Yan X 2011 *International Conference on New Technology of Agricultural Engineering ICAE 2011* 5943995 pp 1162-1166
[5] Medvedeva T 2013 *European Applied Sciences* 5-2 pp 145-148
[6] Dibrova Z, Nosov V, Ovchenkova G, Karpenko E, Pilyugina A, Erkovich E 2018 *International Journal of Mechanical Engineering and Technology* 7 9 12 pp 387–394
[7] Mamai O, Nekrasov R, Parshova V 2018 *Proceedings of the 19th International Scientific Conference* pp 189-196
[8] Nosov V, Kozin M, Andreev V, Surzhanskaya I, Murzina E 2016 *Research Journal of Pharmaceutical, Biological and Chemical Sciences* 7 6 pp 382–385
[9] Pan J 2018 *Journal of Advanced Oxidation Technologies* 21 2 201705773
[10] Ju J, Zhao L, Wang J 2016 *Transactions of the Chinese Society of Agricultural Engineering* 32 2 pp 84-91
[11] Huang H, Yun Z, You L, Wu J 2011 *International Conference on Management and Service Science MASS 2011* 5998516
[12] Yun Z, Huang H 2010 *Transactions of the Chinese Society of Agricultural Engineering* 26 2 pp 253-258
[13] Uzun V, Shagaida N, Lerman Z 2019 *Land Use Policy* 83 pp 475-487
[14] Loizou E, Karelakis Ch, Galanopoulos K, Mattas K 2019 *Agricultural Systems* 173 pp 482-490
[15] Chen J, Dimitrov S, Pun H 2019 *Omega* 86 pp 42-58
[16] Guillen J, Asche F, Carvalho N, Polanco J, Villasante S 2019 *Marine Policy* 104 pp 19-28
[17] Lowder S, Bertini R, Croppenstedt A 2017 *Global Food Security* 15 pp 94-107
[18] Ren Ch, Liu Sh, van Grinsven H, Reis S, Gu B 2019 *Journal of Cleaner Production* 220 pp 357-367
[19] Daniel F, Perraud D 2009 *Journal of Environmental Management* 90 2 pp 132-138
[20] Bochtis D, Sorensen C, Busato P 2014 *Biosystems Engineering* 126 pp 69-81
[21] Ženka J, Slach O, Krtička L, Žufan P 2016 *Applied Geography* 71 pp 83-94
[22] Colombo M, Croce A, Guerini M 2013 *Research Policy* 42 9 pp 1605-1623
[23] Minh Th 2019 *Agricultural Systems* 173 pp 268-280