Current methods of formation of agricultural machinery park in the conditions of Lipetsk region

Iuliia Korotkich¹, Iuliia Chutcheva¹* and Vitalii Bogdanov¹
¹Russian Timiryazev State Agrarian University, Moscow, Russian Federation

E-mail: yuv.chutcheva@yandex.ru

Abstract. Agricultural machinery has a special influence. Nowadays, the state of the material and technical base of the agribusiness is a deterrent to technological modernization. Over the past 20 years, the machine-tractor park and energy supply have decreased more than 2.5 times. The current direction of sustainable development for agriculture is modernization of the technological sphere of production. On the example of Lipetsk region, the article considers the current condition of the crop production industry, identifies agricultural culture, which has priority cultivation in the region and considers the dynamics of the number of agricultural machineries in the region. In order to determine the role of agricultural machinery on grain yield, we have determined quantitative changes in the dependence of grain yield on the factors providing it by means of correlation and regression analysis, after which a close link has been revealed between the availability of agricultural machinery and yield. After the analysis, there were proposed the current directions of reproduction of the material and technical base of enterprises of the agro-industrial complex of Lipets region, exactly, the creation of machine and technological stations to provide small and medium-sized agricultural producers with equipment for cultivation of crops, which would help them to process the available land area in a timely manner. Support from the State is a special role in reproducing the material and technical base of the agro-industrial complex. It is worth noting that currently the existing benefits and subsidies allocated to support agriculture are more applicable for large agro-industrial complexes, thus small and medium-sized agricultural producers are left without appropriate support. It is important to ensure a system of state support in such way that is taken into account the proportionality of this support among large, medium and small agricultural producers.

1. Introduction
In recent years, the agriculture of Lipetsk region has reached a qualitatively new technological level. With 1.5% of the Russian ration in use, the region produces 3% of the Russian volume of grain, meat and meat products, 10% - sugar beet.

Crop production is the main branch of agriculture of Lipetsk region. In terms of the volume of produced crop production in value terms Lipetsk region is on the 14th place among the regions of Russia. In the structure of sown areas of the region, the largest share, as for 2018, is winter and spring wheat (32% of all areas), winter and spring barley (18%), sunflower (12%), sugar beet (9%), corn per grain (7%), winter and spring raps (3%).

Figure 1 shows the percentage of sown area structure in the Lipetsk region in 2018 [1].
The obtained data in Figure 1 characterize that the growing of cereals is a priority agricultural direction in Lipetsk region. Favorable weather conditions and the black earth of the region are a contributing factor for their cultivation.

Figure 2 shows the dynamics of gross grain collection of Lipetsk region from 2009 to 2018. Production is carried out under conditions of small-scale production, which complicates issues of technical support to a certain extent and improvement of grain production efficiency.

Figure 3 shows the dynamics of the presence of tractors in the Lipetsk region. The results of the analysis showed that the largest number of tractors purchased was in 2018 (174 units), from 2015 to 2018 there was a decline in the number of tractors [2].

Figure 4 shows the availability of combine harvesters in the Lipetsk region. From 2015 to 2018 there was an increase in equipment. In 2018, the number of purchased equipment decreased by 33.6%, the main reason for it was the deterioration of financial results of agricultural organizations [2].
2. Methods
After the analysis of the cultivation of winter wheat in Lipetsk region, it is necessary to determine the role of agricultural machinery in the efficiency of production of this type of crop, exactly, to determine the dependence of quantitative changes in the yield of cereals on the factors ensuring it by conducting correlation-regression analysis.

To establish correlation dependence, we use data from 1995 to 2016 for all agricultural organizations of Lipetsk region.

For correlation regression analysis were used STATISTICA 10 and Excel.
The design model was built on five factors:
X1 - is for tractors per 1000 hectares of ploughed field, pieces;
X2 - per 1000 hectares of harvesters, pieces;
X3 - mineral fertilizers applied per 1 ha of grain crops, kg;
X4 - the share of grain crops in the total area of crops, %;
X5 - power capacity per 1 employee, hp

To improve the model, it was carried out a multi-step correlation consisting of 22 observations with step-by-step exclusion of factors.
While including all factors in the model, the most significant parameters were:
X1 - for tractors per 1000 hectares of pasty, pieces;
X5 - power capacity per 1 employee, hp

However, multicollinearity may be observed between variables, so these values are not the final solution.
At the last step of regression, the final factor of influence is obtained - X1 - for tractors per 1000 hectares of pasty, pieces.

3. Results

The results of the regression analysis are shown in Table 1.

| Table 1. Results of the regression analysis. |
|---------------------------------------------|
| Multiple R                  | 0.78 |
| R – square                   | 0.61 |
| Rated R-square               | 0.59 |
| Standard error               | 5.16 |
| Significance F               | 0.000018 |
| Quantity of observations     | 22 |

Let's interpret the obtained values:

As a result of the decision the following correlation and regression equation is received: Y = 82.77 + 3.1X1 + 2.49X2 + 0.062X3 + 0.214X4 + 0.76X5 which analysis showed:

- increase in the number of tractors per 1000 ha of ploughed field by 1%, it leads to an average increase in yield by 3.31%;
- increase in the number of combine harvesters per 1000 ha by 1% leads to an increase in grain yield by 2.49%;
- increase of the amount of added fertilizer by 1 ha by 1% leads to increase of grain yield by 0.06% on average;
- an increase in the proportion of grain crops to the total area of crops by 1% leads to a decrease in grain yields by an average of 0.214%;
- increase of energy capacity per 1 person by 1% leads to increase of grain yield on average by 0.76% [3].

Degree of accuracy of the description of model of process, R-square it is equal 0.74 (74%) that characterizes high precision of approximation (the model describes process well). Multiple correlation coefficient R = 0.86 indicates close link between results and factor characteristic.

The validity of the results by the level of significance of Fisher’s criterion (Significance F < 0.05) is significantly less than 0.05, which means high significance of the model. The degree of accuracy of the R-square process description by the model is 0.60897 (61%), which characterizes the high accuracy of approximation (the model describes the process well). Multiple correlation coefficient R = 0.78 indicates close connection between results and factor characteristic [3].

4. Discussion

After the calculations, it can be concluded that the availability of agricultural machinery has a direct impact on the yield of crops in general, which is a relevant direction of studying ways of reproducing the material and technical base and developing the availability of agricultural machinery within the region.

Currently, the Government of the Russian Federation provides subsidies to agricultural producers for the purchase of agricultural machinery. However, most of the money flows to large agro-industrial enterprises, and small and medium-sized enterprises are left without appropriate support [4, 5].

One of the promising directions of reproduction of material and technical resources of enterprises of the agro-industrial complex we consider the organization of machine and technological stations in the region, which can provide small and medium-sized agricultural producers with both large agricultural equipment (combiners, tractors of large class) and means of small mechanization on the terms of lease or leasing. Such organizations will also be able to offer farmers a set of means and programs of maintenance of agricultural machinery.

The following conditions are necessary for successful and efficient operation of the process stations:

1. Identification of potential users of machine and process station services;
2. Definition of scope of works and list of services provided by machine and technological stations;
3. Existence of the starting capital;
4. Availability of modern energy-saturated equipment, as well as modern means of small mechanization;
5. Availability of highly qualified personnel able to be responsible for quality maintenance and operation of modern equipment;
6. Low cost of works performed and services provided;
7. Validity of prices for performed works and provided services.
8. Availability of own repair base [6].

The application of technological innovations and the provision of highly qualified personnel, both in the field of agriculture and engineering, play an important role in the efficiency of the operation of machine-processing stations.

Interaction of machine-processing stations with agricultural producers is based on resource provision of both.

In order to increase the efficiency of the machine and technology stations, we consider it advisable to create multifunctional machine and technology stations, which in addition to the main activity - carrying out mechanized works for agricultural producers, will work in close connection with selection stations, dealer and information and consulting centers, educational institutions, both higher and medium-professional education, training or retraining centers of specialists [7].

In addition to the above, we propose the use of geographic information systems in MTS, which will be able to collect data from all over the region, process the results and provide advisory services to agricultural producers.

The integration of such organizational structures is aimed at achieving high-tech, scientific, educational and organizational-economic results in order to increase the efficiency of agricultural production and solve issues of food security of the country

5. Summary
Thus, we have established the direct impact of the availability and condition of agricultural machinery on the yield of crops and have identified the priority direction of modern development of the reproduction of the material and technical base in Lipetsk region. These directions are not final and will be a further subject of research and development of the latest approaches to reproduction.

6. References
[1] Official website of statistics of Lipetsk region
[2] Korotkikh Yu S and Chutcheva Yu V 2016 The modern state of machine and tractor fleet of the Russian Federation: main trends and development perspectives (International Technical and Economic Journal) 6 25-29
[3] Zinchenko A P, Shibalkin A E, Tarasova O B and Shaikin E B, 2003 Statistics Workshop (Moscow: Kolos) 392
[4] Belyakov G P, Rizhaya A 2019 State support of technological development of industrial companies: foreign experience (Russian Economic Bulletin) 2 (5) 32-39
[5] Revkutz A B, Demchenko C K, Vasilyev E P 2019 The reproduction approach as a study methodological tools of the effectiveness of the public sector functioning (Modern Economy Success) 5 111-118
[6] Korotkikh Yu S 2019 On the issue of forming a machine and tractor fleet of agricultural producers in the Lipetsk region (International Scientific Konf. and special dedication to 150th anniversary of A V Leontovich) 319-322
[7] Chutcheva Yu V, Korotkikh Yu S and Pulyaev N N To the issue of tractor’s renewal in the Russian Federation (Economics of Agriculture of Russia) 5 19-24