Evaluation of the availability of forage harvesting equipment and prospects for its market development in the Russian Federation

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Abstract. Animal husbandry has been one of the priority areas for the development of agriculture in the Russian Federation over the past decade. One of the factors which gave impetus to its development is the adoption of policies of import substitution, which led not only to increased demand for livestock products due to the limitation of imports from countries that joined sanctions against Russia, but also the development of production sectors that ensure the functioning of this direction of agriculture, in particular agricultural engineering enterprises, producing forage machinery and equipment for maintenance of beef and dairy herds. The analysis of dynamics of changes of quantitative composition of the forage machines fleet shows that over the past three decades there has been a steady tendency to its permanent reduction, due primarily to a decrease in the number of livestock and, as a consequence, the reduction of lands under fodder crops and the general trend of increasing the saturation of machines in agriculture that can significantly increase their productivity. Along with obvious advantages, such as, for example, saving fuel and lubricants and wages due to a reduction in the number of runs on the field, such trends carry a number of risks associated with possible downtime to eliminate the consequences of failures and, as a result, violation of agrotechnical harvesting deadlines. Foreign companies that have moved their assembly plants to the territory of the Russian Federation and have fulfilled the requirements for localization of production often leave the production of spare parts outside its borders, which can not be considered as a positive factor from the point of view of food security. State support, which until recently was mainly directed at equipment manufacturers, did not fully stimulate the implementation of research and development work that could increase the competitiveness of national products over foreign ones, all other things being equal. These factors together dictate the need to conduct research on the prospects for the development of its market.

1. Introduction

The state program for the development of agriculture and regulation of agricultural products markets for 2013-2020, which was extended by Government Decree No. 98 of February 8, 2019 for the period up to 2015, aims to ensure the food independence of Russia in accordance with the Doctrine of food security of the Russian Federation, approved by Presidential Decree No. 120 of January 30, 2010. As
the second goal, accelerated import substitution is proposed for pork, poultry and cattle, the production of which is directly dependent on the availability of feed and means of its reproduction, so the market for agricultural machinery in this area remains quite capacious. An additional impetus to the development of this area of agriculture was given by the sanctions imposed against our country and aimed at weakening Russia’s position in the world economic arena [1, p.19], which, however, gave additional competitive opportunities to national enterprises of agricultural producers.

The increase in demand for machinery and equipment is due to the fact that after a significant decrease in the number of cattle from 57043 thousand heads in 1990 to 18151.4 thousand in 2018 (including cows from 20556.9 to 7942.3 thousand), pigs – from 38314.3 to 23726.6, according to the results of 2019, a positive trend can be noted: 18126.0, 7964.2, 25163.2 thousand heads, respectively [2]. The positive trend is primarily associated with the implementation of the State program, while considering the trends in the field of agricultural engineering, it should be noted that state support for this industry has a double goal: along with contributing to the implementation of the Doctrine of industrial safety by reducing dependence on both food imports and its means of production – machinery and technologies, the industry is quite significant in the structure of industrial production and employment of the population.

The main manufacturers and suppliers of forage harvesting equipment in the Russian Federation market are LLC KZ Rostselmash, Klaas, John Deere, Case New Holland. Forage harvesting equipment, primarily automotive, is currently represented by high-performance energy-saturated machines, the cost of which is quite high, so it requires state support mechanisms, both for equipment manufacturers and its buyers.

Based on the current situation, it seems appropriate to analyze the dynamics of changes in the number of farm animals, the quantitative composition of the forage harvester fleet in the Russian Federation, the areas occupied for feed crops and the load per unit of equipment; to identify the causes of these processes and assess the prospects for the market of grain harvesting equipment in Russia.

2. Materials and methods

The object of study is the production potential of agricultural engineering in the Russian Federation. The sources of information were departmental statistical data of the Unified interdepartmental information and statistical system (UIISS, 2020), final and operational reports of the Ministry of Agriculture of the Russian Federation, report and national reports on the progress and results of the State program for agricultural development and regulation of agricultural products, raw materials and food markets.

Mathematical and statistical data processing was performed using generally accepted methods of economic analysis. The monographic method, methods of expert assessments, analysis and synthesis were used to justify the development directions.

3. Results

Forage harvesters are agricultural machinery intended for harvesting forage crops. According to the principle of aggregation, automotive, trailed and semi-mounted vehicles are distinguished. Depending on the tasks and areas to be processed, an automotive combine is used for harvesting high-quality silage or a trailer unit for mowing thin-stemmed grasses.

3.1 Dynamics of changes in the quantitative structure of the Russian Federation’s grain harvesting equipment fleet

Optimal formation and rational use of the material and technical base is one of the main conditions for arranging the work of an agricultural producer. The Russian market of equipment for meat and dairy cattle breeding remains quite capacious. Most manufacturers of imported automotive, trailed and mounted forage harvesters are trying to increase their share of sales in the Russian Federation. The Doctrine of ensuring food security of the Russian Federation notes that one of the priorities of national agriculture is a systematic gradual reduction of dependence not only on imported products, but also on
technologies, equipment and machinery. The country’s food security in the livestock sector is possible only if there is national engineering in this area. Forage harvesting equipment is often a key factor in the functioning of the meat and dairy production system, so the formation of the technical potential of meat and dairy cattle breeding should not be limited to milking machines and equipment of cowsheds.

An analysis of the dynamics of changes in the number of cattle and pigs over the past five years, shown in table 1, shows that their number in farms of all categories was constantly decreasing, and only in 2019 there was a positive trend in the categories “cows” and “pigs”.

The positive dynamics is primarily related to the implementation of the National Security Doctrine of 2020, approved by Decree of the President of the Russian Federation No. 120 of 30.01.2010, which is aimed at providing the country’s population with reliable food products and developing the national agro-industrial complex, which provided for the accelerated development of animal husbandry.

Table 1. Livestock of farm animals in the Russian Federation (at the end of the year, thousands of heads).

| Organization category | Year | 2015   | 2016   | 2017   | 2018   | 2019   |
|-----------------------|------|--------|--------|--------|--------|--------|
| **Organizations of all categories** |      |        |        |        |        |        |
| Cattle                |      | 18620.9| 18346.1| 18294.2| 18151.4| 18126.0|
| (including cows)      |      | 8115.2 | 7966.0 | 7950.6 | 7942.3 | 7964.2 |
| Pigs                  |      | 21405.5| 21924.6| 23075.5| 23726.6| 25163.2|
| **Agricultural organizations** |      |        |        |        |        |        |
| Cattle                |      | 8447.8 | 8355.9 | 8252.2 | 8139.3 | 8107.5 |
| (including cows)      |      | 3387.4 | 3359.5 | 3315.7 | 3283.0 | 3274.1 |
| Pigs                  |      | 17601.8| 18390.6| 19843.1| 20827.9| 22418.5|
| **Households**        |      |        |        |        |        |        |
| Cattle                |      | 7931.8 | 7567.2 | 7500.8 | 7400.4 | 7289.7 |
| (including cows)      |      | 3621.9 | 3426.8 | 3400.2 | 3360.8 | 3329.6 |
| Pigs                  |      | 3335.3 | 3079.5 | 2805.9 | 2520.9 | 2408.2 |
| **Peasant farms and individual entrepreneurs** |      |        |        |        |        |        |
| Cattle                |      | 2241.3 | 2423.0 | 2541.3 | 2611.7 | 2728.8 |
| (including cows)      |      | 1105.9 | 1179.7 | 1234.7 | 1298.5 | 1360.5 |
| Pigs                  |      | 468.4  | 454.6  | 426.6  | 377.7  | 336.5  |

A high degree of modernization of the technical base of leading enterprises in the field of animal husbandry has made it possible to make production highly profitable [3], while it should be noted that according to some researchers, the share of “strong” enterprises in agriculture that rely on modern technologies and new equipment is about 10% of the total number of enterprises of agricultural producers. Weaker enterprises operate national equipment or equipment purchased on the secondary market and make up about 30% of the total number. More than half of enterprises use simplified technologies and worn-out equipment [4].

The data presented in table 1 show that over the past five years, despite the decline in the number of cattle (including cows) in agricultural organizations, they are leaders in their industry, and at the end of 2019, the number of pigs in them was more than 8 times higher than the number in households and farms taken together, and, in contrast, the number of pigs in agricultural organizations in the last decade shows stable growth.

When analyzing the availability of grain harvesting equipment for agricultural producers in the Russian Federation, it should be noted that along with a significant decrease in the quantitative structure of the fleet by more than 10 times from 122.6 thousand units in 1991 to 11.8 thousand units in 2019 [5], there was a reduction in the area occupied by forage crops – from 44039 thousand hectares in farms of all categories to 15417 thousand hectares in the corresponding period. Thus, despite the reduction in the area, the elimination occurred at a faster pace. Dynamics of changes in the
fleet of grain forage harvesting equipment is shown in table 2.

**Table 2.** Fleet of the main types of forage harvesting equipment in the Russian Federation (at the end of the year, PCs).

| Type of the equipment | 2015  | 2016  | 2017  | 2018  | 2019  |
|-----------------------|-------|-------|-------|-------|-------|
| Forage harvesters     | 14,042| 13,260| 12,681| 12,250| 11,772|
| Mowers                | 32,168| 30,959| 30,483| 30,062| 29,822|
| Tractor rakes         | 15,135| 14,443| 14,081| 13,801| 13,483|
| Balers                | 20,883| 20,370| 19,912| 19,571| 19,493|

The National Report “On the progress and results of the implementation of the State program for agricultural development in 2019” noted: “179 forage harvesters were implemented within the framework of the departmental project “Technical modernization of the agro-industrial complex”, while a total of 1,182 forage harvesters were delivered in 2013-2019 during the implementation of Rules No. 1432, however, as of January 1, 2020, 13.9 thousand forage harvesters were registered by agricultural producers, that is, compared to the previous year, their fleet has decreased by 775 units. It also notes that, despite the quantitative reduction in the fleet of forage harvesters, the share of machines with a service life of more than 10 years decreased from 42.7% in early 2019 to 41.74% in early 2020. In total, 624 forage harvesters were purchased by agricultural producers through all sales channels in 2019, which is 4% less than in 2018 [7, p. 100].

By Decree of the Government of the Russian Federation No. 375 of March 31, 2020, the State program for the development of agriculture and the development of markets for agricultural products, raw materials and food for 2013-2020 was extended until 2025 and involves two stages: program – 2013-2017 and project – 2018-2025. The changes made to the state program aim to increase the renewal rate of forage harvesters to 4.3% [8, p. 5].

### 3.2 Distribution of the forage harvesting equipment fleet of the Russian Federation by Federal districts.

The number of forage harvesting equipment in the Federal districts of the Russian Federation is not uniform and reflects the level of animal husbandry. As of the beginning of 2010, almost a third of all machines were located in the Volga Federal district, and the smallest number of such units is located in the Far Eastern and North Caucasus Federal districts – 1.98 and 2.96 percent, respectively. Data on the availability of forage harvesting equipment for Federal districts are presented in table 3 [6].

**Table 3.** Availability of forage harvesting equipment in the Russian Federation by Federal districts (at the end of the year, units).

| Type of the equipment | Federal district | 2015  | 2016  | 2017  | 2018  | 2019  |
|-----------------------|------------------|-------|-------|-------|-------|-------|
| Forage harvesters     | CFD              | 3,189 | 2,955 | 2,825 | 2,764 | 2,717 |
|                       | NWFD             | 1,012 | 976   | 924   | 871   | 850   |
|                       | SFD (since 29.07.2016) | 938   | 896   | 846   | 777   |       |
|                       | NCFD             | 415   | 380   | 373   | 358   | 349   |
|                       | VFD              | 4,632 | 4,408 | 4,230 | 4,085 | 3,895 |
|                       | UFD              | 959   | 892   | 838   | 830   | 790   |
|                       | SFD              | 2,644 | 2,511 | 2,390 | 2,261 | 2,160 |
|                       | FEFD             | 208   | 200   | 205   | 235   | 234   |
| Mowers                | CFD              | 7,743 | 7,450 | 7,438 | 7,408 | 7,736 |
|                       | NWFD             | 2,290 | 2,244 | 2,094 | 1,985 | 1,985 |
|                       | SFD (since       | 3,899 | 4,004 | 3,969 | 3,908 |       |
3.3. National forage harvesting equipment
Thus, the products of LLC “KZ “Rostselmash” are presented as automotive forage harvesters, and trailed equipment. The range of automotive machinery is presented by model combines of DON 680M and RSM series that are aggregated with a unsupported header with a cutter bar continuous cut for harvesting stemmed the silo series Maize Header, with headers for harvesting leaves stemmed silage with unsupported cutter bar continuous cut Grass Header, a pickup rolls drum-rake type For Up. At the same time, a significant competitive advantage is the fact that the entire product line of LLC “KZ “Rostselmash” is offered to agricultural enterprises of all subjects of the Russian Federation on the terms of preferential leasing, namely: advance payment – from 0%, preferential price increase from 3%, lease term – up to 7 years, no requirements for guarantee, while the financing conditions can be combined with other Federal and regional support measures.

The pace of technical modernization of the forage harvesting equipment fleet has increased significantly in recent years, while the share of machines produced by national enterprises has also increased. Russian manufacturers are beginning to crowd foreign companies, which a decade ago occupied up to 75% of the market.

4. Discussion
From the point of view of production distribution, the agricultural machinery industry of the Russian Federation is represented by a number of companies specializing in the production of various types of agricultural machinery and which occupy up to half of the volume of national production. One of the main competitive advantages of national agricultural machinery is its low cost. Nevertheless, the increase in energy saturation and technological efficiency leads to the expansion of the model range, as a result of which the price of machines is approaching the level of foreign competitors. At the same time, there is a danger that due to insufficient funding for research, this equipment may be inferior to its foreign counterparts in terms of its consumer characteristics.

The dynamics of demand for forage harvesting equipment depends on the dynamics of changes in
areas, which, in turn, is associated with the development of animal husbandry. In the period up to 2030, it is planned to introduce additional areas for forage crops, which is associated with the planned development of both dairy and meat livestock. The estimated demand for forage harvesters in the Russian Federation in 2021 is projected at 1,060 units, in 2025 – at 1,510, in 2030 – at 1,890. The growth rate of demand in 2017-2030 will be 7%. The market value will reach 8.9 billion rubles by 2021 and 14.2 billion rubles in 2025, in 2030 – 20.0 billion rubles [9, p. 16]. At forecasting demand and planned development, in our opinion, it is necessary to take into account regional features that are associated not only with traditional activities of agricultural enterprises, but also with the level of investment attractiveness of the region, as this factor is important not only for the development of the economy at the regional level, but also indirectly stimulates the development of the entire economy, and also supports manufacturers of agricultural machinery even with indirect foreign investment [10, p. 38].

The dynamics of demand for trailed forage harvesting equipment is related to the acquisition of machine-technological complexes, so the demand for mowers and rakes correlates with the demand for tractors, and the need for balers and rakes depends on the number of cows. The projected total volume of the trailer equipment market in 2021 is estimated at 41.7, in 2025 – 47.1, in 2030 – 53.4 thousand units [9, p. 18].

5. Summary
The Russian market of grain harvesting equipment has such a high capacity that even state support for Russian producers can provide some competitive advantages for foreign companies that have met the localization requirements and transferred the required production volume to the Russian Federation [11, p. 381].

In some segments of the agricultural machinery industry in the Russian Federation, there is a tendency to monopolize the market. Currently, it is planned to change the mechanism of state support for the industry by switching from direct subsidies to producers to subsidizing preferential leasing, which is due to the threat of monopolization of the industry and insufficient rates of technical modernization of agriculture.

However, we can also note the sharp criticism of this reform, primarily from the largest recipient of state support - Rostselmash, whose representatives claim that it is the existing mechanism that has allowed increasing the production of national agricultural machinery and expanding its range.

Taking into account the different forms of ownership of agricultural producers and the difference in their financial position, the state policy of support for Russian agricultural engineering enterprises should also take into account support for the development of the secondary market of machinery.

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