



## Prospects for Import Substitution of the Equipment in Forming Machine Utilization Systems in the Agriculture of Siberian Federal District

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### ABSTRACT

The goal of the research is to determine perspectives for import substitution of the equipment in the agriculture of Siberian Federal District (SFD). The paper contains methods for analyzing import substitution perspective lines, including sequential performance of the following stages: First, analysis of technical equipment of agriculture branches in the region that provides for assessment of availability of the main types of agricultural equipment. The second stage includes assessment of the renewal rate of the equipment fleet the most in demand in the region. On this stage one should calculate number of the equipment purchased within the research period, as well as ratio of new equipment in the general fleet that was identified on the first stage. The third stage provides for identification and analysis of import of the main equipment, and determination of equipment import ratio within the research period. The fourth stage includes determination of import importance for equipment renewal in the regional agribusiness and validation of priorities of import substitution in forming the machine utilization system in the agriculture. As the result of the research the offered methods were tested on the materials of SFD of the Russian Federation. The authors determined and validated priorities for equipment import substitution for the regional agriculture, as well as economic effects of import substitution.

**Keywords:** Import Substitution, Agriculture, Machine Utilization Systems, Economic Efficiency, Agribusiness Technical Equipment

**JEL Classifications:** O33, Q16, Q17

### 1. INTRODUCTION

Modern agribusiness is a capital-intensive and high-tech industry. Technologies and tools applied in the agriculture have been developed and updated for centuries. Such development resulted in effective agricultural production methods and machine-and-technology complexes to perform them.

Modern agricultural machine utilization systems are of high technological effectiveness that means not only application of new materials and complex production technology, but also installation of modern electronic control systems with onboard computers on the equipment. High requirements of modern agricultural

technologies to their technical support and necessity in complex machine utilization systems are objective causes for formation of a part of machine-and-technology complexes based on import.

Relevance of equipment import substitution in forming agricultural machine utilization systems is stipulated by the following factors: (1) Strategic role of the agriculture for national safety with regard to decrease of dependence on imports of the agrifood market and food safety; (2) promotion of national technologies in terms of agricultural equipment production; (3) development and implementation of the national quality and ecological safety standards in the sphere of formation and application of machine utilization systems and agricultural production.

The goal of the research is to analyze prospects for import substitution of the equipment in forming machine utilization systems in the agriculture of Siberian Federal District (SFD).

Achievement of the goal provides for solution of the following tasks: (1) Analysis of scientific publications with regard to formation of machine utilization systems and development of import substitution processes in the agriculture; (2) development of methods to determine perspectives for equipment import substitution in the agriculture; (3) test of the developed methods on SFD materials; (4) validation of perspectives for equipment import substitution in forming the machine utilization systems in the agriculture of SFD.

The papers by Krasnoshchekov and Malyshev (2010) and others consider assessment of machine utilization in the agriculture, and the papers by Kuzmin (2009), Khabardin et al. (2009), Zhalnin (2013) and others discuss increase of technological and economic efficiency of application of machine utilization systems.

Import of agricultural equipment, its growth and regulation, including economic crisis periods, is covered by Chebykina and Usov (2008), Sergeeva (2010), Shut (2012), Varlamov and Kulov (2009), Voityuk (2015), Volynets-Russet (2015) and others.

Problems of import substitution in forming machine utilization systems in the agribusiness are discussed in papers by Serdobintsev (2014), Lyalin et al. (2014), Ignatenko and Mozgovoy (2015), Iovlev and others.

In spite of considerable interest of scientific community to problems of forming effective machine utilization systems in the agriculture, within import substitution conditions inclusive, methodological issues of determining prospects for agricultural equipment import substitution are still understudied. The available methods (Alatenko, 2015) are mainly focused on specific machine utilization systems and dedicated to technological and economic efficiency of equipment utilization, with regard to import substitution inclusive.

Effective management of process technologies in the agribusiness on the regional level requires developing methods for determination of prospects for agricultural equipment import substitution.

## 2. METHODS

### 2.1. General Requirements

Analysis of scientific publications enabled to form the main requirements that are to be met by the methods of determining perspectives for agricultural equipment import substitution:

1. The methods are to be multifunctional and suitable for analysis both on the regional and national level;
2. The methods are to be focused on analysis of prospects for equipment import substitution in crop and animal production;
3. The methods are to be complex and oriented to all participants of the import substitution process, including national equipment producers, as well as agricultural producers that form and operate machine-and-technology complexes directly;

4. The methods are to be resulted in determination of economically feasible vectors of development of agricultural equipment import substitution for the analyzed region.

The methods offered by the authors are focused on analysis of perspective vectors of import substitution in forming machine utilization systems in the agriculture of a large region and include two blocks: First, analysis of technical equipment of the main agriculture branches and its time history; second, analysis of import of the main types of equipment in forming the machine utilization systems, identification and assessment of import substitution prospects.

Application of the methods provides for performance of sequential stages, which implementation will answer the following questions: What are the perspective vectors for development of agricultural equipment import substitution in the region and what is their economic effectiveness.

### 2.2. Content of the Methods

The first stage of the methods includes analysis of technical equipment of the agriculture branches in the region that provides for assessment of availability of the main agricultural equipment. The specific feature of agriculture development in the current context in Russian regions is a combination of crop and animal production in agricultural organizations and farms of the agribusiness. Analysis of technical equipment provides for determination of the main agriculture branches, which are the biggest and the most important for the region. Development of import substitution particularly in these regions may have the biggest positive socio-economic effect. One of the most objective methods of validating branch importance for the region is a ranking based on economic management (Marzhokhova et al. 2014; Davydova and Devyatkina, 2011). SFD is one of eight federal districts in Russia that enables to apply ranking to agriculture branches of the district and to rank each branch across the country in whole.

Thus, the first stage of the methods refers to:

1. Ranking of the main branches of crop and animal production with regard to volume of produced goods;
2. Identification of the most important branches in the region based on ranking results;
3. Analysis of technical equipment in these branches - availability of the main agricultural equipment and its time history.

Implementation of this stage results in identification of equipment the most in demand among agricultural producers in the region. Specialization of the regions and their priorities in technical equipment will be different depending on climatic zones.

The second stage includes assessment of the renewal rate of the equipment fleet the most in demand in the region. On this stage one should calculate number of the equipment purchased within the research period, as well as ratio of new equipment in the general fleet that was identified on the first stage. At assessing the fleet renewal rate some requirements are specified to initial data: For the purpose of analysis it is necessary to take into account

purchase of new equipment only. This requirement is stipulated by the fact that in forming machine utilization systems, involving import equipment, new machinery and not the second-hand one is used in most cases. Beside the new agricultural equipment market, in Russia there is the mature aftermarket, where they sell second-hand equipment that is in demand among small agricultural organizations and farms.

Upon implementation of this stage we get information on the main tendencies in the process of technical equipping of the agribusiness in the region. In future this information may be used for identification of perspective vectors of import substitution in forming machine utilization systems in the regional agribusiness.

The third stage provides for identification and analysis of import of the main equipment, and determination of equipment import ratio within the research period. Following the third-stage one can determine economic results of import for the region that are expressed in cash outflow directed to purchase of import equipment.

The fourth stage includes determination of importance of import for equipment renewal in the regional agribusiness and validation of priorities of import substitution development in forming the machine utilization system in the agriculture.

The offered methods were tested on the materials of SFD.

### 3. RESULTS

#### 3.1. Analysis of Technical Equipment and Equipment Renewal in the Main Agriculture Branches

SFD is located on 30% of Russian territory with population of 20.5 mln. people. The district contains 16 subjects, including one of the biggest grain production regions in Russia - Altai Krai, Omsk and Novosibirsk oblasts. Farmland area in the region amounts to 567 mln. ha. (Image Processing Laboratory at the Institute of Computational Mathematics and Mathematical Geophysics SB RAS, official site, 2015). The agribusiness in SFD is represented by animal and crop production, deep processing of agricultural raw materials, as well as facilities to produce agricultural equipment. Grain production is a dominant branch in crop growing. Animal production is represented by dairy breeding and beef raising, poultry and pig husbandry.

Grain production is one of the priorities in crop growing in SFD. That's why import substitution in forming machine utilization systems in this branch is topical for the region. Importance of the grain branch for the region is confirmed by the ranking, Table 1. Ranking is made on the basis of data on the annual grain gross collection across federal districts of the Russian Federation (Unified Interdepartmental Statistical Information System, official site, 2015).

For the last 4 years the grain branch in SFD ranks the 4<sup>th</sup> in Russia with production of 8-15 mln. t grain per year depending on weather that amounts to 12.5-16.5% of total grain gross collection in the country.

Within this research the authors have studied elements of machine utilization systems for the grain industry designated for performance of key agrotechnological operations: Basic cultivation, seeding and harvesting. Weather conditions in SFD and modern tendencies in agrotechnologies increasingly stimulate agricultural producers to apply subsoil tillage in order to minimize topsoil impact. Cultivator is one of the key elements of the machine utilization system at such cultivation. Seeder is the key element of the seeding machine-and-technology complex. Please, find the grain seeders analysis in Table 2. In SFD harvesting is performed both by the straight-combine and separate method. Thus, you may also see the analysis of availability of combine harvesters and windrowers in Table 2.

Weather conditions in SFD, including vast range lands and herbs, are favourable to develop dairy breeding. Besides, there are huge milk processing facilities in the region. Lyubinskiy milk processor - the largest in Russia - is located in Omsk oblast. Within the research SFD ranks the 3<sup>rd</sup> in terms of milk production (in 2011 - the 2<sup>nd</sup>). Agricultural producers of the region manufacture more than 5.5 mln. t milk yearly that amounts to app. 18% of total milk production in Russia. All these factors as a whole actualize the analysis of import substitution in dairy breeding.

Tractor is one of the key elements of machine utilization systems in majority of agrotechnological operations. That's why it is necessary to include tractors into the analysis of technical equipment of agricultural branches (Table 2). Please, find the analysis of technical equipment of agriculture branches in Table 2.

Table 2 shows decrease of all types of equipment in SFD in 2014 against 2010. The biggest decrease concerns seeders (30.4%). Decrease of combine harvesters, tractors, windrowers and cultivators within the research period amounts to 25-28%. Number of milking machines has been decreased by 11.2% for 5 years. The tendencies can be explained by aging of the equipment and end-of-life disposal. Purchase of new equipment does not compensate the disposal that is connected with financial difficulties of agricultural producers in the region. In such a case it should be noted that excess of the disposal rate over the delivery rate of new equipment in the current context is an objective process, because productivity of new patterns is much higher. If equipment quantitative decrease trend does not come amid decreasing agricultural production, this process is to be referred to as farming intensification. This particular case one can see in SFD, because agricultural production has increased more than 1.3 times for the last years in the region (Unified Interdepartmental Statistical Information System, official site, 2015).

Thus, fair technical resources of the grain industry and dairy breeding is of key importance for efficient and stable development of the agriculture in the region. Table 3 contains data characterizing equipment renewal process in the agribusiness of SFD.

Table 3 shows decrease in new equipment purchase in SFD since 2011. In 2014 against 2011 agricultural producers decreased purchase of combine harvesters by 39.9%, tractors - 55.3%, seeders - 59.6%, windrowers - 39.5%, cultivators - 46.1%, new milking machines and units - 42.4%.

**Table 1: Ranking of effectiveness of the main agriculture branches in SFD, 2010-2014**

Federal district	Grain gross collection, rank					Milk production, rank				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Southern	1	1	2	2	1	4	4	4	4	4
Central	3	3	1	1	2	2	3	2	2	2
Volga	5	2	3	3	3	1	1	1	1	1
Siberian	2	4	4	4	4	3	2	3	3	3
North Caucasian	4	5	5	5	5	5	5	5	5	5
Ural	6	6	6	6	6	6	6	6	6	6
Northwestern	7	8	7	7	7	7	7	7	7	7
Far Eastern	8	7	8	8	8	8	8	8	8	8

**Table 2: The analysis of technical equipment of agriculture branches in SFD in 2010-2014, pieces**

Equipment	2010	2011	2012	2013	2014	2010 to 2014 %
Combine harvesters	16,972	15,752	14,552	13,321	12,197	71.9
Tractors	53,911	50 110	47,196	43,678	40,300	74.8
Seeders	26,697	24 064	22,175	20,357	18,580	69.6
Windrowers	6,793	6 309	5,840	5,442	4,983	73.4
Cultivators	12,992	12 089	11,312	10,345	9,593	73.8
Milking machines and units	5,938	5,852	5,707	5,501	5,272	88.8

**Table 3: Renewal of the main equipment in the agriculture of SFD, 2010-2014**

Equipment	2010	2011	2012	2013	2014
Combine harvesters					
Purchase, pcs.	569	726	458	539	441
Renewal, %	3.4	4.6	3.1	4.0	3.6
Tractors					
Purchase, pcs.	942	1,753	1,209	1,022	783
Renewal, %	1.7	3.5	2.6	2.3	1.9
Seeders					
Purchase, pcs.	298	542	471	380	219
Renewal, %	1.1	2.3	2.1	1.9	1.2
Windrowers					
Purchase, pcs.	256	276	187	205	167
Renewal, %	3.8	4.4	3.2	3.8	3.4
Cultivators					
Purchase, pcs.	252	393	272	198	212
Renewal, %	1.9	3.3	2.4	1.9	2.2
Milking machines and units - total					
Purchase, pcs.	172	304	271	201	175
Renewal, %	2.9	5.2	4.7	3.7	3.3

Percentage of equipment renewal with regard to tractors, seeders and milking machines has a definite downtrend. In 2014 ratio of new tractors in the regional farms amounted to 1.9% of their total quantity, seeders - 1.2%, milking machines - 3.3%. There is no new combine harvesters, windrowers and cultivators trend within the research period. By the end 2014 share of new combine harvesters amounted to 3.6%, windrowers - 3.4%, cultivators - 2.2%.

### 3.2. The Equipment Import Analysis in SFD

Table 4 shows equipment import in the agriculture of SFD in 2012-2014. The Table 4 demonstrates that equipment renewal in SFD is 1.1-4.7%. At that, the peak of combine harvesters, tractors and cultivators import was reached in 2013. 13 combine harvesters, 562 tractors and 75 cultivators were imported in SFD in 2013. Seeders import was decreased by 49.2% in 2014 against 2012 and amounted to 61 pieces. For the last 3 years windrowers import has been increased more than 6 times and amounted to

75 pieces. They have purchased 6 imported milking machines and units, including 4 purchased in 2012.

Equipment import ratio in total purchase volume sufficiently varies by year and by branch in forming machine utilization systems in SFD. We can see the smallest import ratio with regard to milking machines and units - 0.5-1.5%. Combine harvesters import is in similar situation, where maximum import ratio is 2.4%. The mentioned equipment ranks among the most high-technology types with regard to the items presented in Table 4. At that, results of the analysis prove that Russian equipment manufacturers almost completely cover the needs of agricultural producers in SFD.

Seeders import share has remained as 25-28% for the last 3 years that proves some import dependence. Referring to cultivators one can notice decrease of import share from 20.6% to 9% in 2014 against 2012 that means decline of import dependence.

Tractors import ratio has increased from 35.3% to 65.6% for the last 3 years. Windrowers have the same tendency, where import share has increased from 6.4% in 2012 to 44.9% in 2014 in forming machine utilization systems. Equipment import share growth means increasing dependence of the agriculture in SFD on import deliveries in forming machine utilization systems. And such dependence with regard to tractors is critical, because <35% of new tractors are domestically produced. Under tense international climate and sanction policy towards Russia current situation is a source for potential threat to the stable operation and development of the agriculture in SFD. Thus, decline of tractors and windrowers import dependence in the regional agriculture is one of the priorities of import substitution development in forming machine utilization systems.

## 4. DISCUSSIONS

The conducted analysis enabled to determine the main equipment with the highest import dependence. Figure 1 shows that tractors,

windrowers and combine harvesters have the highest dependence. Requirements in other types of equipment are almost completely met due to Russian manufacturers.

Potential import substitution with regard to tractors amounts to app. 500 pieces, windrowers - 30-70 pieces, seeders - to 60 pieces, cultivators - to 19 pieces per year. In spite of a relatively small number of combine harvesters imported to SFD (5-7 pieces per year) this line is to be also considered as a perspective one as combine harvesters are high-technology and expensive products. Besides, Russia has production facilities enabling to manufacture combine harvesters world competitive in all parameters.

Table 5 contains data needed for analysis of economic results of agricultural equipment import substitution in forming machine utilization systems in SFD.

Data from Table 5 show serious economic results of using import equipment in forming machine utilization systems in the agriculture of SFD. Outlay for import equipment in the region amounted to more than RUB 1.7 bln. in 2012-2014. These funds were paid to foreign equipment suppliers from China, Canada, Germany, USA, Belarus, Kazakhstan, France, Italy (Federal Customs Service of the Russian Federation, official site, 2015). In 2013 outlay of regional agricultural producers for purchase of import equipment was the highest (app. RUB 750 mln.), and in 2014 it was the lowest for the last 3 years - RUB 491.6 mln.

Results of the research prove a sufficient economic effect from developing import substitution of agricultural equipment that can be earned by local suppliers, if machine utilization systems in the agribusiness of SFD with usage of Russian equipment are formed. The most promising line of import substitution in forming machine utilization systems in the regional agribusiness in relation to the direct economic effect is substitution of import tractors for local ones. At that the direct economic effect will be more than RUB 200 mln. per year. Russian equipment suppliers will get minimum RUB 100 mln. per year due to substitution of import seeders for locale ones. Substitution of the other import equipment for local

Figure 1: Import ratio in purchase of new equipment by agricultural producers in Siberian Federal District, 2014

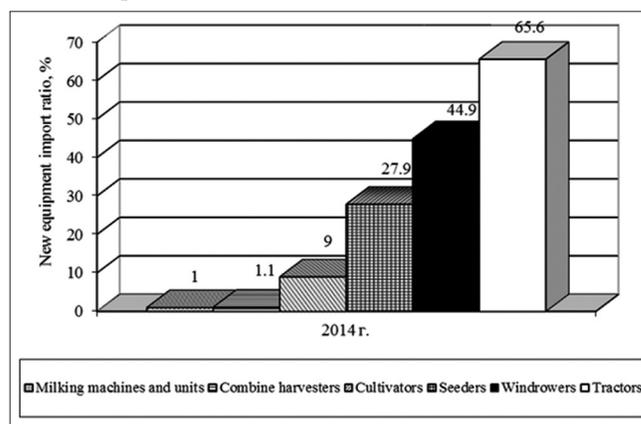


Table 4: Import of the main equipment in the agriculture of SFD, 2010-2014

Equipment	Item	2012	2013	2014
Combine harvesters	Renewal, %	3.1	4.0	3.6
	Import, pcs.	7	13	5
	Import share in new equipment purchase, %	1.5	2.4	1.1
Tractors	Renewal, %	2.6	2.3	1.9
	Import, pcs.	427	562	514
	Import share in new equipment purchase, %	35.3	55.0	65.6
Seeders	Renewal, %	2.1	1.9	1.2
	Import, pcs.	120	94	61
	Import share in new equipment purchase, %	25.5	24.7	27.9
Windrowers	Renewal, %	3.2	3.8	3.4
	Import, pcs.	12	34	75
	Import share in new equipment purchase, %	6.4	16.6	44.9
Cultivators	Renewal, %	2.4	1.9	2.2
	Import, pcs.	56	75	19
	Import share in new equipment purchase, %	20.6	37.9	9.0
Milking machines and units	Renewal, %	4.7	3.7	3.3
	Import, pcs.	4	1	1
	Import share in new equipment purchase, %	1.5	0.5	0.6

Table 5: Outlay for purchase of the main equipment in the agriculture of SFD

Items	2012		2013		2014	
	Thous. USD	Thous. RUB	Thous. USD	Thous. RUB	Thous. USD	Thous. RUB
Total import, including	15,966	494,949	23,417	749,329	12,796	491,625
Combine harvesters	1,555	48,217	1,366	43,711	623	23,945
Tractors	6,101	189,135	6,722	215,095	5,903	226,803
Seeders	6,383	197,866	11,893	380,562	2,676	102,796
Windrowers	449	13,912	517	16,549	2,314	88,892
Cultivators	1,327	41,132	2,882	92,234	915	35,155
Milking machines and units	151	4,687	37	1,178	365	14,036

Reference: Mid-year dollar exchange (The Central Bank of the Russian Federation, official site, 2015): 2012-31 RUB, 2013-32 RUB, 2014-38,4 RUB

one will enable to get the direct economic effect amounting to RUB 14 to 80 mln. per year.

## 5. CONCLUSION

The conducted research enabled to validate prospects for developing import substitution in forming machine utilization systems in the agriculture of SFD. The direct economic effect is a ground for determining perspective lines of import substitution based on the offered methods. The direct economic effect is expressed as outlay for purchase of import equipment by agricultural producers – these funds could be in the economy of Russia and serve for support and development of local equipment manufacturers.

Further development of the offered approach to validation of prospects for import substitution in forming machine utilization systems in the agriculture is to include determination of both direct and indirect effect. Indirect effect is to be studied taking into account the following aspects:

1. At validating prospects for import substitution in technical equipment of the agribusiness it is necessary to account not only for import equipment price, but operating costs as well, which can influence the choice of agricultural producers between local and foreign suppliers;
2. Apart from operating costs it is necessary to account for the level of service and availability of spare parts, which can also have a sufficient influence on import substitution efficiency;
3. Assessment of economic effect from substitution of import equipment for local one is an important aspect due to possible changes of agricultural products quality;
4. This is the comprehensive approach to the problem of developing import substitution of equipment in the agribusiness.

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