

Research Article

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**Material and Technical Base of Agricultural Organizations as the
Basis for their Economic Efficiency**

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ABSTRACT

Innovative development, availability of a material and technical base, search for new market outlets, etc. are important issues for agricultural organizations, farm enterprises, and personal subsidiary plots at present. The current business environment in Russia compounded by economic sanctions takes the importance of agricultural situation in the country to a new level. At this date, development of the agribusiness industry has a direct impact on the number of people employed in the economy, degree of village infrastructure development and living standards in rural regions, food safety of the country, population health, state of other economic branches, inflation and a lot more.

An optimal set of equipment with maximum operating and energy efficiency is a prerequisite to food safety of the country in case of problems with livestock industry and fodder production. The domestic agricultural machinery market is generally crippled by inconsistency with the main parameters of non-price competition. Thus, there is a need to systematize the factors that influence effective decision-making, decision analysis and ranging, decision-making given the potential of a certain company. The authors devised a method to analyze the agricultural equipment market, with the possibility to build a scheme at the regional level. They determined the most important parameters influencing machinery market formation by the example of Nizhny Novgorod region. They considered the possibilities of determining the most significant factors for optimizing operation of agricultural organizations. The research identified two major factors providing a competitive market position of manufacturing companies: factor 1 “Technical and technological modernization of production” and factor 2 “Qualitative composition и safety”. Influence of the factors allows determining competitive status and development perspectives of the agricultural equipment market in terms of non-price competition parameters. The cluster analysis grouped respondents as follows: “Quality”, “Financial support”, “Social factor”, and “Technical outfit”. The research findings can be used to improve strategic planning, quality control systems, to satisfy social business

requirements. Factor interrelation analysis permits identifying areas for efficient management actions to improve company operation.

Key words: economic efficiency, agricultural organizations, cluster analysis, evaluation parameters, material and technical support, factor analysis, performance efficiency.

INTRODUCTION

Material and technical support is one of the primary means to bring about sustainable development to agricultural production. Now the Russian engineering industry tends to reduce provision of farming lands with sophisticated machinery. There is no consumer demand for emerging machinery. Retirement of domestic machinery is 6-10% and replenishment of machine and tractor fleet is less than 1% per year correspondingly. According to the Russian Institute for Mechanization, the favorable ratio is 16 tractors and 7.5 grain harvesters per 1000 ha of arable lands. The actual numbers are 5.1 and 3. This demonstrates a large gap with developed countries, in particular, 3.4 times with the USA and 5-10 times with the Western European countries. Technical facilities must be increased 2-3.5 times to provide agriculture with the required amount of machines and vehicles. Total agricultural area of the region is 2811.5 thousand ha including 1961 thousand ha of arable lands. This makes 1.5% and 1.7% of the corresponding figures of Russia. Agricultural organizations (hereinafter AO) have the largest agricultural output, 53.0%. As of 2014, agricultural organizations of Nizhny Novgorod region numbered 4760 tractors, 1555 ploughs, 1479 seeding machines, and 1530 cultivators. The rate of old machinery disposal (5.6% of tractors and 6.5% of cultivators) continues to exceed the rate of machinery upgrade (3.3% and 2.9% correspondingly). Pursuant to the State Programme for the Development of Agriculture for 2013-2020, development of the domestic agricultural market is primarily aimed at meeting food safety requirements and raising competitive capacity of agricultural goods. A key focus in implementing the lines of domestic market development is evaluation and systematization of the factors of increased performance of agricultural vehicles,

introduction of resource-saving technologies, application of high-performance machinery and equipment in agriculture.

Rapid development of the agricultural equipment market and successful operation of the machine and tractor fleet serve as one of the most important means ensuring efficient performance of every agricultural goods producer under the current conditions of economic management. Market formation and utilization of efficient market management tools are one of crucial areas of agricultural production improvement, with this justifying urgency of the research.

Performance of any agricultural organization is evaluated using a system approach since all production processes are interrelated, that is, based on a consistency principle. Some factors have direct impact while others indirectly affect this indicator. Analysis of factor impact on the values under study is one of the main aspects in analyzing financial and economic activities of an organization because the resulting indicator intrinsically depends on many factors. Thus, detailed research of factor impact on the resulting indicator value ensures perfect analysis and evaluation of quality indicators of organization operation.

Analysis of the existing situation has shown that there are material uncertainties among agricultural goods producers in regard to agri-food market development. Therefore, this case requires further study of agricultural organization operation.

Market development challenges were studied in the works of such economists as N. E. Astashov, V. A. Artamonov, V. P. Arashukov, A. V. Rebrov, M. E. Braslavets, T. A. Burtseva, I. V. Snimshchikova, O. V. Fokina, L. A. Fufacheva, G. V. Redreyev [1, 2, 3, 4, 5, 7, 13, 14] and others. Agricultural equipment arrangement and operating features were treated in the works and scientific experiments of such scientists as I. N.

Burobkin, V. M. Kosolapov, T. I. Lobacheva, V. A. Sysuyev, A. V Savinykh, M. Yu. Semenov [6, 8, 9, 10, 11, 12].

We studied agricultural organization infrastructure theory of domestic and foreign authors and came to a conclusion that there was a need for market development technology with established priorities. It is highly important for practical purposes to identify the parameters influencing quality of goods produced under the prevailing conditions of economic management. This allows fulfilling a range of tasks:

- formation of an agribusiness industry development strategy;
- employment of modern resource-saving technologies in agricultural goods production;
- competitive recovery measures for agricultural organizations;
- implementation of a quality management system for agricultural goods and evaluation of goods balance.

Advances in the market management technology will substantially simplify a planning and forecasting system. The factor analysis will enable to determine lines of agricultural organization development and to evaluate their performance efficiency. Utilization of the management technology and factor analysis meets system approach requirements. This is very important for agriculture industry development at different levels. In this respect, one should start determining management

technology stages with the complex analysis of strategic development and management priorities using economic and mathematical methods.

We appraised opinions of contemporary scientists and industry experts and defined the following problems that hamper fodder market development:

1. Depreciation of machine and tractor fleet and equipment, utilization of inferior cultivation technologies that do not comply with up-to-date resource-saving requirements.
2. Low quality of domestic fodder of all types.
3. Inept utilization by organizational leadership of new processing technologies and high-yield crops.
4. Increased importation of grain volume in the absence of a surplus fund at the grain fodder market.
5. Lack of combined fodder additives on the Russian market, which causes dependence on high-priced import deliveries.
6. Weather conditions [17, 18].

METHODS

One of the main aspects in market formation is evaluation of the factors that determine agricultural machinery quality and competitiveness. Here is a scheme of the proprietary technology and its principal stages to determine the parameters influencing quality and safety management efficiency of agricultural machinery (Figure 1).

Principal stages of determination of significant factors that influence agricultural machinery market formation in Nizhny Novgorod region	
X ₁	Balanced composition
X ₂	Special program requirements, government support
X ₃	Milk yield
X ₄	Range of activities of agricultural producers (feed milling segment)
X ₅	Cost of agricultural equipment
X ₆	Change in the exchange rate
X ₇	Agricultural equipment modernization level
X ₈	Availability of in-house production
X ₉	High accessibility level
X ₁₀	Grain, pulse harvest
X ₁₁	Food import ban
X ₁₂	Paying capacity of agricultural goods producers
X ₁₃	Fodder grain quality (pathogenic grain)
X ₁₄	Product uniqueness
X ₁₅	Animal percentage in personal subsidiary plots

	Qualitative analysis	
Results of factor analysis of research data		<p>Factor 1: X₂, X₄, X₅, X₇, X₈, X₁₂. Factor name: “Technical and technological modernization of production”</p> <p>Factor 2: X₁, X₃, X₉, X₁₃, X₁₄. Factor name: “Qualitative composition and safety”</p>
	Quantitative analysis	
Results of cluster analysis of research data		<p>Cluster 1: “Quality” X₁ (Retail price level) X₄ (Service maintenance) X₃ (High quality level) X₁₄ (Range completeness)</p> <p>Cluster 2: “Financial support” X₅ (Leasing availability (concessional lending)) X₁₃ (Encouragement of investments) X₁₁ (Business strategy of a manufacturing company)</p> <p>Cluster 3: “Social factor” X₁₀ (Social government policy) X₉ (Society standard of living) X₂ (Confirmed money equivalent)</p> <p>Cluster 4: “Technical outfit” X₈ (Type of POL) X₁₅ (Production intensification level) X₁₆ (Operating characteristics)</p>
<p>Figure 1. Results of evaluation of the factors that determine agricultural machinery quality and competitiveness</p>		

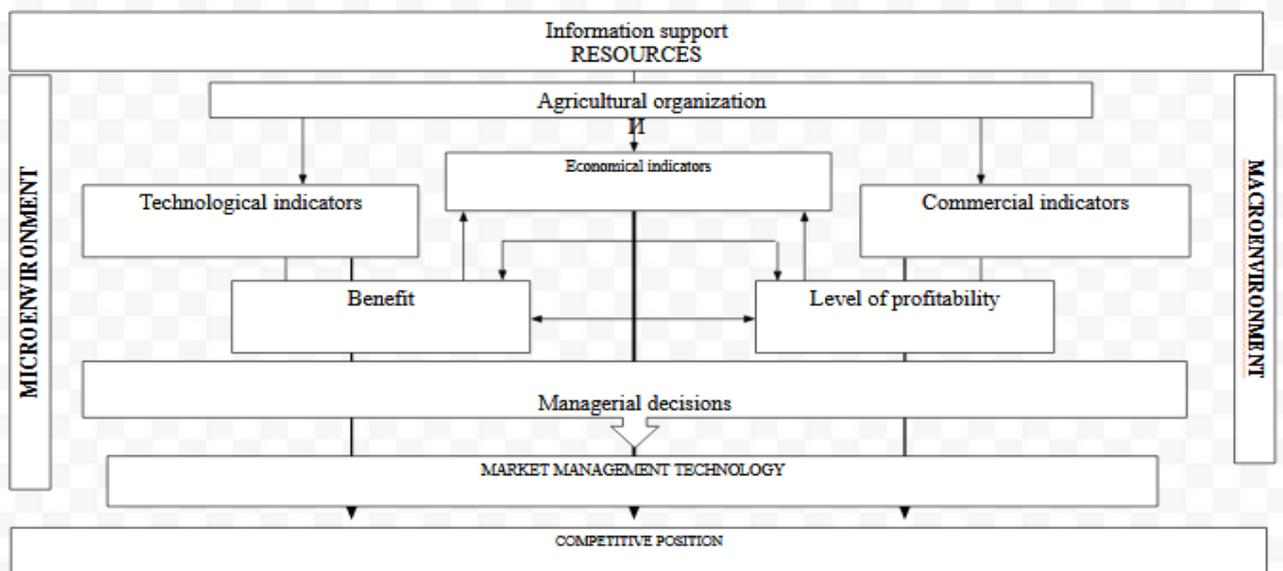
The technology of determination of the significant factors during market formation and development is of key importance for competitiveness management and food safety. The market management technology consists of sequential operations that comprise various research methods and mechanisms for management decision-making. Based on the analysis of literature sources and existing problems in the industry, we propose the market management technology subject to implementation of government support programs for agricultural goods producers and

provision of competitive market position. The procedure integrating all elements is indispensable for these purposes in order to provide competitive position of organizations.

Figure 2 presents evaluation of economic efficiency of market management improvement measures. Market management efficiency is evaluated with three groups of indicators: technological, economical, and commercial. Figure 2 shows a generalized chart of company performance efficiency.

Figure 2. Organization performance evaluation scheme

A company uses an articulate management



technology to produce high-quality goods that are competitive with imported goods and can eventually surpass their market competitors [19, 20, 21, 22].

RESULTS

First of all, we conducted exploratory research to list the main parameters that correspond to competitive position of home-made agricultural machinery at the existing market and can influence competitiveness in general. Then, we formed a panel of experts in the field of the research by interviewing them. The research identified 15 parameters characterizing agricultural machinery competitiveness and quality ($x_1 - x_{15}$). The findings were processed in a statistical program using the factor analysis procedure.

We pursued studies on the market of Nizhny Novgorod region concerning perception of the factors of agricultural machinery quality and competitiveness. The studies showed that the market formation guidelines were “technical and technological modernization of production” and “qualitative composition и safety”. In this connection, we believe that the factor and cluster analysis procedures must be used as one of the most important means to monitor domestic machinery quality and availability. They will allow identifying the main factors (directions) of fundamental modernization and dynamic growth in production of domestic agricultural equipment.

Here are successive steps of the cluster analysis:

Table 1. Analytical data of clustering and profiling

Step No.	Number of clusters	Distance	Combination of groups		New cluster	Number of clusters in a new cluster
1	49	0,0000	4	5	4	2
2	48	2,8284	45	48	45	2
3	47	2,8284	45	46	45	3
4	46	2,8284	44	45	44	4
5	45	3,0000	10	44	10	5
6	44	3,1623	6	7	6	2
7	43	3,6056	10	47	10	6
8	42	3,7417	2	6	2	3
9	41	3,8730	27	40	27	2
10	40	4,0000	10	26	10	7
11	39	4,1231	2	27	2	5
12	38	4,5826	2	13	2	6
13	37	5,0000	10	32	10	8
14	36	5,0990	10	42	10	9

Selection of a distance measurement method and clustering procedure. Division into groups and assignment to a particular group by matching or distinguishing features. Selection of a distance measure. Manhattan Distance is considered optimal for market formation research. We used a classification approach through hierarchial analysis in a statistical program package.

Construction of a dendrogram to decide on division into cluster groups (Fig. 2). This diagram demonstrates the ratio of the total variance inside the groups to the between-group variance that shows corresponding number of clusters.

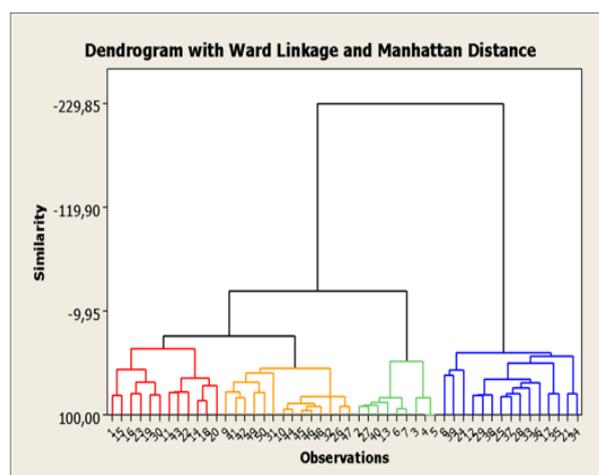


Figure 2. Decision on the number of clusters
The data in Table 1 is used to analyze and estimate distances of the cluster dendrogram. Profiling of the clusters is carried out in terms of the variables obtained as a result of processing in the statistical program package.

15	35	5,1962	10	43	10	10												
16	34	5,1962	2	10	2	16												
17	33	5,7446	2	14	2	17												
18	32	6,0828	3	4	3	3												
19	31	6,3246	2	50	2	18												
20	30	6,4031	25	28	25	2												
....																		
40	10	7,8740	1	16	1	31												
41	9	7,9373	12	33	12	11												
42	8	8,0623	1	17	1	33												
43	7	8,1240	1	12	1	44												
44	6	8,8318	1	15	1	45												
45	5	10,1489	1	20	1	46												
46	4	10,2470	1	39	1	47												
47	3	10,5357	1	8	1	48												
48	2	11,0000	1	31	1	49												
49	1	13,3791	1	24	1	50												
Cluster		Percentage, %																
1		32																
2		19																
3		23																
4		26																
Averages over clusters																		
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆		
1	8,9	9,2	7,7	7,5	5,8	6,7	7,2	8,5	7,6	8,9	5,0	6,1	8,4	8,2	7,4	5,5		
2	9,7	10,0	9,1	9,1	9,4	9,0	8,7	9,7	9,7	9,7	8,1	8,1	9,8	9,9	9,7	6,3		
3	6,7	7,7	6,1	5,6	6,2	4,6	5,3	6,9	6,3	5,1	3,7	4,7	4,9	5,5	4,1	3,3		
4	9,2	8,6	7,9	7,5	8,2	8,3	8,1	7,8	7,7	6,9	6,6	8,1	7,1	7,0	7,9	6,2		
Cent	8,4	8,7	7,5	7,2	7,2	6,9	7,1	8,0	7,6	7,3	5,6	6,6	7,2	7,3	6,9	5,2		
Cluster centroids																		
1		0,0000					7,5853					8,8429					5,9568	
2		7,5852					0,0000					15,1745					7,7558	
3		8,8429					15,1745					0,0000					8,7484	
4		4,9548					6,6559					9,7784					0,0000	

DISCUSSION

According to the cluster analysis results, respondents are distributed into the following clusters. The first cluster comprises the respondents who place more emphasis on the following indicators: X₁ (Retail price level), X₄ (Service maintenance), X₃ (High quality level), X₁₄ (Range completeness). The group under study includes the respondents who pay attention to quality and service. It is "Quality". The second cluster comprises the respondents who consider X₅ (Leasing availability (concessional lending)), X₁₃ (Encouragement of investments), X₁₁ (Business strategy of a manufacturing company) as the key parameters that determine general consumer properties. It is named "Financial support". These respondents place emphasis on financial support and thus choose to purchase new types of machinery. The third cluster comprises the respondents who

highlight X₁₀ (Social government policy), X₉ (Society standard of living), X₂ (Confirmed money equivalent). This cluster is named "Social factor". It testifies that agricultural goods producers need government support. The fourth cluster includes the respondents who consider X₈ (Type of POL), X₁₅ (Production intensification level), X₁₆ (Operating characteristics) to be the main indicators. The respondents focus only on the parameters that characterize engineering data of agricultural machinery and ignore the other parameters. It is "Technical outfit" [23, 24, 25].

CONCLUSION

We devised a method ready for use during agricultural machinery market formation, with the possibility to build a scheme at the regional level. While approving the method, we identified the most significant parameters that

influence machinery market formation in agricultural production. This analysis enables domestic manufacturers to shape a production development strategy under the competitive position conditions subject to the regional market development factors. It should also be noted that the factor and cluster analysis is of practical importance as far as it can be applied by any companies including those that do not have specially trained staff. Besides, companies usually have limited resources (financial, labour, time). The findings of factor interrelation analysis allow setting the course for effective management actions to improve company performance.

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