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The impact of new production technologies on the efficiency of agricultural enterprises

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Abstract

The article discusses the directions that contribute to improving the development efficiency of flour-milling enterprises, taking into account the effectiveness of the product marketing system via general scientific methods and theories of studying socio-economic phenomena and processes: logical, dialectical, systemic, technological, process and

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situational approaches. It has been shown that the diversification of production is an effective direction for the development of flour milling enterprises. In conclusion, to solve the priority tasks of product quality management in the aspect of ensuring sustainable effective development of the flour-milling industry, it is necessary to improve the equipment and technology of grain processing.

Keywords: Agribusiness, Performance, Production technology, Trends.

El impacto de las nuevas tecnologías de producción en la eficiencia de las empresas agrícolas

Resumen

El artículo discute las direcciones que contribuyen a mejorar la eficiencia del desarrollo de las empresas de molienda de harina, teniendo en cuenta la efectividad del sistema de comercialización de productos a través de métodos y teorías científicas generales de estudio de fenómenos y procesos socioeconómicos: lógico, dialéctico, sistémico, tecnológico , procesos y enfoques situacionales. Se ha demostrado que la diversificación de la producción es una dirección efectiva para el desarrollo de empresas de molienda de harina. En conclusión, para resolver las tareas prioritarias de gestión de la calidad del producto en el aspecto de garantizar un desarrollo eficaz y sostenible de la industria de molienda de harina, es necesario mejorar el equipo y la tecnología del procesamiento de granos.

Palabras clave: Agronegocios, Desempeño, Tecnología de producción, Tendencias.

1. INTRODUCTION

The flour-milling and grain industry is one of the main sectors ensuring food security in many countries (PAOLA, CAPORASO, PAOLA, BOMBELL, VASENEV, NESTEROVA CASTALDIE, & VALENTINIF, 2018), including the Russian Federation. High competition in the flour market requires special attention to the quality

of products and the efficiency of managing flour-milling and grain enterprises (MAYOROVA, 2019).

Today, more than 75 countries have approved the procedure for the mandatory enrichment of flour with iron salts and folic acid. Similar laws have been adopted, including in the United States, Canada, Great Britain, Chile, Kazakhstan, Moldova, Armenia, Azerbaijan, Uzbekistan and several other countries (ALTUKHOV & NECHAEV, 2015). On average, more than 30% of industrial grinding products are enriched in flour in the world.

In Russia, the value of this indicator slightly exceeds 1%. The enrichment of flour is carried out by industry enterprises in the Altai Territory, Bashkiria, Tatarstan, Kemerovo, Tomsk, Ryazan, Leningrad and some other regions of the Russian Federation, even though the necessary technological equipment is available in the vast majority of flour-milling enterprises. And this is with the available statistics (ANTIPOV, ANTIPOVA & BOGOMOLOVA, 2015), which confirms that with the consumption of fortified flour products, the risks of congenital malformations of the nervous system and some types of cancer, as well as the mortality rate from strokes, are significantly reduced. Moreover, the addition of iron, folic acid, vitamins, and minerals to flour contributes to the physical and mental development of children, and also positively affects the maintenance of physical activity and performance of people of almost any age. All this confirms the social effects of using modern technologies to improve the quality of the flour.

2. METHODOLOGICAL FRAMEWORK

The methodological basis of this research was systematic scientific research of a general theoretic and applied nature, devoted to the problems of improving the marketing system and quality management of grain processing products, as well as the scientific results of research organizations on the problems of the consumer market, raw materials and food of the agro-industrial complex.

In the course of the study, general scientific methods and theories for the study of socio-economic phenomena and processes were used: logical, dialectic, systemic, technological, process and situational approaches, as well as general scientific methods of cognition of socio-economic processes: concretization, analysis, synthesis, abstraction. When processing the information and empirical database, application packages of MS Excel and MSWord were used.

3. RESULTS

3.1. Assessment of the current state of development of flour-milling and grain processing enterprises in Russia

The published results of the forecast of the US Department of Agriculture allow concluding that in the coming 2020 forecasted record harvests and stocks of wheat and barley in the world. At the same time, a slight decrease in corn stocks is expected. The same forecast data are presented in the report of the International Grain Council.

Since 2018, Russia has headed the top 10 world wheat exporters, even though the total volume of world wheat exports amounted to 190.6 million tons. The structure of world wheat exports is presented in Figure 1.

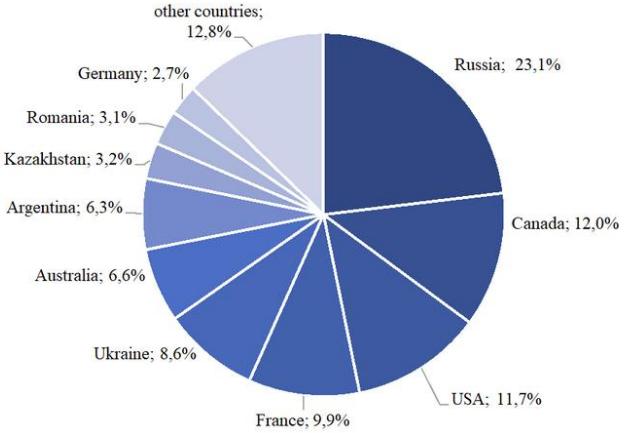

Figure 1: Structure of the world wheat exports, 2018

The rating of the largest buyers of Russian grain is headed by Egypt. Turkey's purchases look even more impressive, primarily in terms of growth rates. It increased the import of Russian grain by 131% to 7.1 million tons.

The pricing policy is influenced by market conditions - low global economic growth and high supply lead to lower grain prices. Also, the development of the coronavirus epidemic had a negative impact on demand.

If we evaluate grain export by Russian producers, then at the beginning of 2020 it will be at a level below its potential, but there is every prerequisite for the fact that by the middle of the year, deliveries abroad can increase due to the competitiveness of Russian grain.

Russian exports are currently below potential, but in the second half of the season (January – June 2020), deliveries abroad may increase due to the increased competitiveness of Russian grain.

3.2. The main trends in the development of flour-milling and grain processing enterprises in Russia

The development trends of flour-milling and grain processing enterprises in Russia over the past period were influenced by significant socio-economic transformations associated with the formation and development of market relations. Food trade plays an important role in improving the food security of each country and will be even more important in the face of climate change.

Contrary to the positive experience of highly developed countries whose industry enterprises use the latest achievements of scientific and technological progress and innovative technologies, which helps to increase their production capacity and reduce the number of organizations, a significant increase in the number of flour, cereals, and bakeries has been recorded in the Russian Federation enterprises while reducing the average daily productivity and the level of coefficients of its use (up to 40 percent or less).

At present, there are many small-scale milling and grain processing enterprises in Russia, the equipment of which does not allow the use of modern technologies and the production of high-quality products.

In recent years, there have been no significant changes in the structure of the range of products in the Russian flour-milling and grain processing industry due to the preservation of consumer habits and preferences. As before, indicators of structural regional distribution of shares in the aggregate volumes of sectoral production are stable, which are largely influenced by the availability of a raw material base and a high concentration of the population.

At present, flour-milling enterprises, in the context of fierce competition to ensure guaranteed sales, must take into account trends in consumer demand for nutrition in favor of healthy, functional, regular consumption products that have prophylactic and health-improving properties that contain unconventional types of raw materials, main vitamins, and minerals.

Flour, especially wheat, corn, and rice, is a popular and common food in the diet of the world's population and has attracted considerable attention as a suitable means for fortifying micronutrients.

3.3. The advantages of using modern technology to improve the quality of products of grain processing enterprises

The experience of many countries shows that their industry experts refused to mix grain of various classes in the production of flour to ensure the required level of gluten content. However, even though in the process

of mixing grain with various qualitative characteristics, the averaging of the gluten content in the flour occurs, this cannot always provide the required baking properties of the flour. Therefore, modern flour-milling enterprises began to use dry wheat gluten as a corrective additive, which allows enriching flour with protein (when adding 1% dry wheat gluten to flour, the content of raw gluten increases to 2.6% with the necessary dosage of 0.5-3%), increase organoleptic characteristics, nutritional value and quality of bread, slow down the process of stagnation of bakery product.

The calculations carried out in the framework of this study confirm that the use of corrective additives to flour is economically advantageous for grain processing enterprises. As an example, we consider the production of flour from class 4 wheat with an actual gluten content of 23%, the level of which is required to be increased to 27-28%. In this case, it is necessary to add dry wheat gluten of about 20 grams per 1 kg of flour. Taking into account the average cost of the improving agent, the introduction of a correcting additive will increase the cost of flour production and will lead to the need to increase the selling prices on average to 2.5-2.7%.

Of course, the increase in prices for the main raw materials for the production of such a socially significant product as bread can cause a similar negative trend in the entire integration chain of grain processing enterprises. However, several advantages of using this technology should be taken into account, which:

- Contributes to an increase in gluten content without the use of mixing processes of “strong” and “weak” grains and the attraction

of additional low-quality grains (fourth and fifth grades) for food purposes;

– Allows you to stably manage the quality of products, meeting the requirements of standards and enriching flour with vegetable protein valuable to human health;

– Makes it possible to reduce the complexity of production and costs of bakery, confectionery and pasta enterprises, which, in turn, will not need to add similar flour fortifiers with protein;
– Provides improved financial results while maintaining the competitiveness of products.

3.4. Calculation of the economic-mathematical model of the impact of the introduction of new production technologies on the efficiency of agricultural enterprises

With the normative requirement of premix (iron and folic acid) in the amount of 1.14 g per 1 kg of flour, the cost of production increases on average by 1.5%. But, at the same time, the load on production capacities increases and conditionally constant costs per unit of production decrease, so the selling price will not change significantly. At the same time, the use of modern grain processing technologies opens up new prospects for flour milling enterprises as organizations with high civil responsibility to expand the market share by improving the quality of flour by bringing the vitamin content to a natural level and increasing its nutritional value. Besides, the development of technological potential enables them to painlessly adapt to the regional market environment by developing

competitive strategies, expanding the geography of sales, clearly segmenting the domestic and foreign markets and identifying priority flour varieties.

To confirm this conclusion by constructing an economic and mathematical model, we optimized the structure of production and sale of flour by type of product produced, including using modern components. As a criterion, the profit obtained from the sale of products of a flour mill is established. The modeling is based on the information of one of the typical domestic industrial enterprises, presented in table 1.

Table. 1: Initial information for constructing an economic and mathematical model for optimizing the structure of the implementation of flour

Indicators	first-class (premium) grade	1_{st} grade	2_{nd} grade	M 55-23	M 75-23	Total
Volume of production, t	20410,76	21173,09	7816,10	6657,64	9390,60	65448,19
Revenue, thousand rubles	332695,41	343427,52	139517,43	107321,1	150249,54	1073211
Cost price, thousand rubles	290776,59	300156,48	121938,57	93798,9	131318,46	937989
Profit, thousand rubles.	41918,82	43271,04	17578,86	13522,2	18931,08	135222

Profit per 1 ton, thousand rubles.	2,05	2,04	2,25	2,03	2,02	-
Costs per 1 ton, thousand rubles	14,25	14,18	15,60	14,09	13,98	-

The objective function will be as follows:

$$Z_{max}=\sum CijXj, \quad (1)$$

where Z_{max} - the amount of profit from the sale of flour; C_{ij} - profit per 1 ton of j-type flour for the I period; X_j is the sales volume of j - that type of flour.

The following variables have been taken as sought:

X_1 - sales volume of premium flour; X_2 - sales volume of flour of the 1st grade; X_3 - sales volume of flour of the 2nd grade; X_4 - sales volume of flour M 55-23, X_5 - sales volume of flour M 75-23.

The following restrictions are imposed on unknown parameters:

1. The optimal plan should be based on the availability of productive resources.

$$\sum_{j=1}^{n} a_{ij} X_{i\,j} \le b_j \quad (2)$$

where a_{ij} is the cost of resources of the j-th type per 1 ton i of that type of flour; b_j is the availability of production resources of the jth type.

2. Variables cannot have a negative value

X_{ij}- >= 0 (3)

The main option for a management decision is to fulfill the following conditions: maintain the existing system of distribution of products through established sales channels; invariability of pricing policy; maintaining production volumes at the current level.

The results are presented in Table 2, while the premix was used only for the production of premium flour.

Table 2: The results of solving the problem of optimizing the structure of the sale of flour, taking into account the use of premix

Indicators	first-class (premium) grade	1_{st} grade	2_{nd} grade	M 55-23	M 75-23	Total
Volume of production, t	26995,04	14556,50	4509,61	8654,93	10732,11	68520,10
Revenue, thousand rubles	440019,15	236106,42	135330,13	139517,43	171713,76	1122686,89
Cost of price, thousand rubles	389808,38	206411,16	118271,71	121947,93	150034,90	986474,08
Profit, thousand rubles.	50210,77	29695,26	17058,42	17569,50	21678,86	136212,82
Profit per 1 ton, thousand rubles.	1,86	2,04	2,25	2,03	2,02	-
Costs per 1 ton, thousand rubles	14,44	14,18	15,60	14,09	13,98	-

The comparative results of solving the problem are shown in table 3.

Table 3: The main economic indicators of the enterprise when using modern methods of flour production

Indicators	Fact	Optimization	Deviation	
			Absolute, +/-	Relative%
Volume of production, %	100	100	0	100
The volume of production of premium flour,%	31	41	10	132,26
The volume of production of flour of the 1st grade,%	32	22	-10	68,75
The volume of production of flour of the 2nd grade,%	13	7	-6	53,85
Объем производства муки М 55- 23, %	10	14	4	140,00
The volume of production of flour M 55- 23, %	14	16	2	114,29
Flour production volume, tons	65448,19	65448,19	6584,28	132,26
including premium grade, tons	20410,76	26995,04	-6616,59	68,75
1st grade, tons	21173,09	14556,50	-3306,49	57,70
2nd grade, tons	7816,10	4509,61	1997,29	130,00
M 55 -23 tons	6657,64	8654,93	1341,51	114,29
M 75-23 tons	9390,60	10732,11	6584,28	132,26
Revenue	1073211	1122686,89	49475,89	104,61
Cost price	937989	986474,08	48485,08	105,17
Profit	135222	136212,82	990,82	100,73
The cost of 1 rub. of products sold	0,90	0,88	-0,02	97,78
Profitability of sales	12,6	12,13	-0,47	96,27
Profitability of products	14,42	13,81	-0,61	95,7

The obtained version of economic calculations can be considered the first support plan for optimizing the objective function. However, despite the percentage of profit increase according to the

plan compared to its actual value, this option can only be partially realized. This is explained by the fact that in conditions of crisis in the economy and a decrease in the effective demand of consumers, it is inappropriate to rely on high demand for premium flour to maintain the competitiveness of the enterprise. However, it is necessary to take into account such a positive aspect as production flexibility, since when using this technology, the enterprise can always produce the necessary amount of high-quality flour at the request of the client.

4. DISCUSSION

Previously, the authors of the article also researched the development of the food industry of the Russian Federation (IVANOVA, TATOCHENKO, JAZEV, ZAITSEVA, LARIONOVA, & VIKHROVA, 2018a; IVANOVA, TATOCHENKO, YAZEV, ZAITSEVA, LARIONOVA, & LAZAREVA, 2018b), managing the resource potential of bakeries in conditions of ensuring food safety (ANTIPOV ET AL., 2015) and improving the management of integration and cooperation processes in the grain processing sector (OMELCHENKO, VASILENKO & BOGOMOLOV, 2018). At the same time, several topical issues of the impact of the introduction of new production technologies on the efficiency of the agricultural enterprises remained unexplored.

This author's study has fundamental differences from several existing ones since the article proved that the most effective direction

for the development of flour-milling enterprises is the diversification of production, which allows saving on transportation costs for the delivery of basic raw materials, and costs associated with marketing research on the acquisition of flour; to ensure the receipt of flour at cost with a subsequent increase in the cumulative effect; reduce the need for the construction of storage facilities for the storage of flour and other types of raw materials.

5. CONCLUSION

A scientific study showed that Russia is currently one of the five world leaders in grain exporters, which is an indicator of the economic potential of the Russian Federation. The emergence of Russia in the international market as a major exporter of grain is crucial not only for global commercial agriculture and food security but also for the country's economy (PAOLA ET AL., 2018).

Export volumes indicate the possibility of ensuring the country's domestic needs for food and food security and also indicate the ability to stably supply significant volumes of food to the world market to strengthen national interests.

However, while a country is increasing its pace in terms of export volumes, on the contrary, opposite trends are observed in quality. This is evidenced by the characteristics of the collection of cereals, namely wheat classes.

To solve the priority tasks of product quality management in the aspect of ensuring sustainable effective development of the flour-milling industry, it is necessary to improve the equipment and technology of grain processing. The use of modern innovative technical and technological solutions makes it possible to better separate the shells from the endosperm of grain and, accordingly, increase the yield of flour of high grades of products, which, as a rule, improves the financial condition of industrial enterprises and flexibly adapts to the market environment of a particular region of the country by based on the production of products in market demand.

The directions that contribute to increasing the development efficiency of flour-milling enterprises are considered, taking into account the effectiveness of the product marketing system.

Orientation to quality management and consumer preferences will allow grain processing enterprises to competently build their assortment and marketing policies, which will ensure high performance and effective functioning in the future.

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