



PAPER ID: 10A12M



RESOURCE-SAVING WASTE-FREE PRODUCTION AS AN INNOVATIVE METHOD OF IMPROVING ENTERPRISES' BUSINESS PERFORMANCE IN THE MEAT PRODUCTION

I.P. Bogomolova ^{a*}, A.V. Kotarev ^b, A.N. Prostenko ^c, A.I. Dobrunova ^c, D. Yu. Chugay ^c

^a Department of Management, Production Organization and Sectoral Economics, Federal State Budgetary Educational Institution of Higher Education "Voronezh State University of Engineering Technologies", 394036, 19, Revolutsii str., Voronezh, RUSSIA

^b Department of Management and Marketing in the Agro-Industrial Complex, Federal State Budgetary Educational Institution of Higher Education "Voronezh State Agrarian University named after Emperor Peter I", 394087, 1, Michurina st., Voronezh, RUSSIA

^c Department of Economic Theory and Economics of the Agro-Industrial Complex, Federal State Budgetary Educational Institution of Higher Education "Belgorod State Agrarian University named after V.Ya. Gorin", 308503, 1, Vavilova st., Maysky settlement, Belgorod district, Belgorod region, Russia of the Rodinsky District of the Altai Territory, RUSSIA

ARTICLE INFO

Article history:

Received 09 May 2019
Received in revised form 22 July 2019
Accepted 30 July 2019
Available online 07 August 2019

Keywords:

Meat management;
food security; Meat
production subcomplex;
Food industry
resource-saving;
Innovative meat
production; Resource
efficiency management.

ABSTRACT

This work explores the issues on the development of resource-saving methods and approaches of meat production, taking into account the innovation and efficiency factors. Using the synthesis, analysis, comparisons, as well as logical, process and system approaches, it is found that many scientists define the "resource-saving" concept often too narrow and trivial, using limited one-way approach to the interpretation of the substantive essence of the definitions and explications of this category. Many scientists consider only the material and financial components, without taking into account the fact the process of resource management and the very essence of a lean approach to the production management system. The resource efficiency management process can improve the quality management system of finished products and the technological process, organizing the transport and logistics and storage conditions (raw materials, food, products), as well as environmental measures. This work highlights and systematizes the main indicators of enterprise resource efficiency, and formulates the conditions for improving the resource efficiency. This study finds that modern enterprises are required to implement the principles of resource-saving: scientific substantiation, complexity, and cost-effectiveness. The resource-saving strategy gives a permanent reduction in resource consumption per unit of the resulting beneficial effect. Also, this paper elaborates the main areas of resource-saving in the agro-industrial sector. The most promising areas of processing and practical use of waste and secondary raw materials of meat production and international experience are proposed.

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1. INTRODUCTION

Under the conditions of a modern market economic system, enterprises of the agro-industrial complex of the Russian Federation function under restrictions of tough competition, high cost of material, raw materials and labour resources, as well as their limitations. At the moment, despite the implemented set of measures in the field of import substitution, a significant niche in the market of food raw and other materials is occupied by foreign producers, which reduces the indicator of food security in our country. This is especially relevant in terms of the technical and technological infrastructure of industrial enterprises of the agro-industrial complex, providing heavily processed products from food stock, production of initial components for composite meat, dairy, and grain products, as well as feed mixtures for the livestock farming.

Taking into account the economic and innovative aspects, we can say that resource-oriented methods and approaches to the food production management system are the most effective and efficient from the standpoint of achieving the most sustainable socio-economic growth and development of the entire domestic AIC at the current moment and in the future. The introduction of effective resource-saving mechanisms in the food production industry will reduce waste, successfully carry out product diversification, reduce direct and indirect costs, including the resource intensity and resource consumption indicators, and ultimately increase the level of profitability, capitalization and competitiveness. It is worth noting that the quality and intensity of the technical and technological development of food industry enterprises, including those of meat production, are highly determined with many social, economic, financial, environmental and organizational factors. The success of adaptation and the application effectiveness of new technical and technological solutions depend not only on the level of their industrial feasibility but also on the degree of provision with "long" investments that can be justified only within the framework of the innovative resource-saving strategy. The transition to market relations at the beginning of the XXI century predetermined the difficult financial situation of research organizations and enterprises of the food industry, which were earlier engaged in the development of advanced resource-saving technologies. In the end, the introduction of developed technologies slowed down and ceased; this currently characterizes the situation of a significant underrun of domestic science and practice compared to foreign food industry enterprises in the field of resource-saving and resource consumption.

Thus, in our opinion, the basis for improving economic efficiency and sustainability should be a mechanism for enhancing the actual and potential capabilities of a business entity (labor, financial and economic, organizational and managerial, social and legal, information technology, research, intellectual) aimed at improving the socio-economic situation and its competitiveness. One of such important reserves is the careful attitude to all types of resources used and the deep processing of all by-products and waste of meat-processing production. As the result of our study, we have established that the loss of resources depends on endogenous and exogenous factors: inefficient methods of raw materials transportation and storage; low rates of intra- and inter-sectoral cooperation

between enterprises with raw materials and technological ties; the imperfection of technological processes for processing and reprocessing of raw materials (high energy and resource intensity); the technical and technological development level does not comply with the principles and approaches of material, labor, energy-saving; lack of staff motivation in the implementation of resource-oriented methods of labor organization and production process (material resources and raw materials saving and prudent attitude to them); low organization and production culture; the lack of effective methods and approaches from state authorities aimed at stimulating modern food production to resource-saving, introducing resource-saving technologies, and also technologies for the deep processing of raw materials.

Thus, the foregoing proves the high degree of relevance of the subject area under study and determines the need to solve practical problems aimed at improving the efficiency of the meat production subcomplex enterprises based on the application of scientifically grounded methods and approaches to resource-saving.

2. GOALS AND TASKS

The aim of the study is a comprehensive exploration of theoretical and applied achievements in the field of resource-saving and waste-free production of meat products. The main conceptual provisions are based on the processing of secondary raw materials and meat processing resources in the aspect of improving the efficiency and innovativeness of the business subjects in the sector. The stated goal determined the basis for the objectives: to conduct a study of the essence and content of the category “resource-saving”, taking into account domestic and foreign experience of setting and interpreting problematic issues in the field of resource-saving and resource consumption; to determine the basic aspects of the resource-saving mechanism formation; to analyze the main problem points that restrain the innovative development of domestic meat production in the conditions of development, adaptation and application of low-cost and waste-free technologies within the entire functional and technological vertical of the meat production subcomplex; to explore the most promising areas of the integrated raw meat, by-products, and waste use, taking into account technological, organizational and managerial components.

3. METHOD AND MATERIAL

A theoretical and methodological basis for the scientific research were the theories, methods, concepts, as well as applied research of domestic and foreign scientists in the field of efficient management of meat processing production under the conditions of innovative type resource-oriented approach application. In the process of achieving the goal and solving the designated tasks, the following methods of understanding the production and economic processes in the meat processing industry of the agro-industrial complex were applied: synthesis, analysis, comparisons, and also logical, systemic and process approaches.

4. RESULTS AND DISCUSSION

In modern economic conditions, the organization of resource-saving has undergone very significant changes (transformations), and in some cases, the nature and forms of these changes have extraordinary manifestations. This is due, first of all, to changes in the production and business process management model, the formative development of the market environment, changes in principles and approaches to property management and business, violation of well-established intra- and inter-industry cooperation links. Modern risks and uncertainties of the market business model (imperfect competition; shortage and high cost of financial resources and long-term investments; problems associated with monopolization of industry markets; lack of an effective mechanism for managing product quality based on the application of safety and utility principles; distribution of profits between participants in market relations (procurers, producers, consumers, intermediaries, end-users, suppliers); imperfection of regulatory and legal regulation by supervisory authorities; problematic issues in the field of fiscal support), set the trend and future need for the development and application in practice of advanced achievements in resource-saving, as well as organizational and management decisions aimed at activation of measures to improve the resource efficiency of industry actors, taking into account the innovation, permanence and utility factors [16, 21].

At the present stage, there are still discussions in scientific circles and there are inconsistencies on individual issues regarding the organization, planning, accounting, control, evaluation and implementation of resource-saving methods and approaches. All this proves once again the need and relevance of conducting scientific research in the resource-saving and resource consumption area in the relevant specialized fields and areas of entrepreneurial activity. At the same time, it must be emphasized that even today many scientists characterize the “resource-saving” concept often too narrowly and trivially, applying a limited one-sided approach to interpreting the substantive essence of the definitions and explications of this category. Many scientists focus only on the material and financial components, not taking into account that the resource management process and the very essence of a lean approach to the production management system has a much deeper meaning and logic of understanding [1, 4, 6, 19, 22].

Material consumption and raw materials consumption indicators for manufactured products depend on various kinds of factors which are characterized by a high degree of uncertainty and imitability. The main quantitative and qualitative indicators of resource efficiency in an enterprise are illustrated in Figure 1.

To increase the resource efficiency level of an enterprise, it is necessary to fulfill the following requirements: to ensure a high level of qualification of the company's employees; achieve high intellectual potential of employees; ensure the technical and technological independence of the enterprise; achieve a high level of competitiveness; ensure the legal security of the enterprise and the protection of enterprise information security.

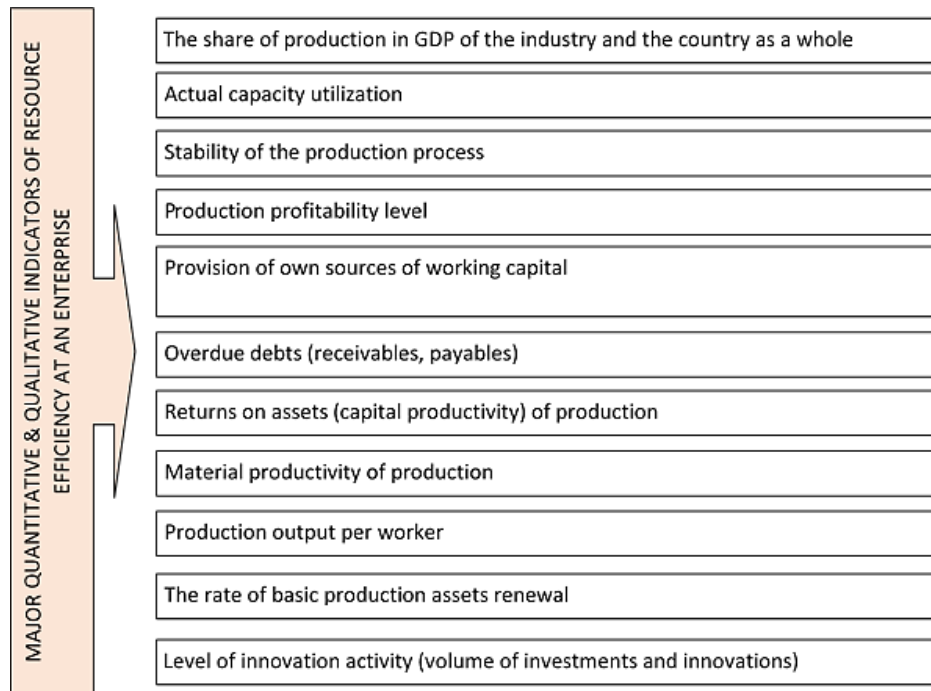


Figure 1. The main indicators of resource efficiency at an enterprise [12, 20]

In the process of organizing an economic activity in modern enterprises, it is required to implement the following resource-saving principles:

- scientific substantiation and provability which imply a balance and proportions between the various interests of society and the environment;
- a complexity which assumes a variety and multiplicity of directions in terms of rational use of material and non-material resources on the basis of low-waste and/or waste-free production;
- permanence which is the process of resource-saving that must be continuous and constant;
- expediency and flexibility which mean that resource-saving should be reasonable and logical;
- determinism and ubiquity which mean that resource-saving as a process should be interconnected with other processes of endogenous and exogenous nature, as well as cover all major areas of production and economic activity in order to obtain the maximum synergistic effect throughout the production and technological chain [18].

Thus, summarizing the results of research carried out by domestic and foreign scientists in the field of formation and ensuring the organization of production on the basis of resource-saving approaches, we came to the conclusion that the resource-saving strategy is a set of principles, factors, methods, models, and measures ensuring a permanent reduction in resource consumption per unit of the resulting beneficial effect.

Turning to the sectoral level, it is worth noting that the issues of resource-saving and resource consumption are very relevant for agricultural production, including for meat processing, since most of them do not receive close enough attention in terms of organizational, economic, production and technological measures aimed at reducing

resource consumption and resource intensity production. This situation has a negative impact on the stability and balance of the meat production development. In this regard, let us present the main directions of resource-saving based on the main resource efficiency principles (table 1).

Table 1. The main directions of resource-saving for the field of agriculture [5, 15]

Direction	Implementation and effect
The introduction of advanced technology	Energy-efficient machinery and equipment; reducing raw material losses and increasing the yield of finished products; reduced resource consumption; increase the shelf life and sales of food products
Interchangeability of used resources and production factors	The use of substitute materials, as well as more cost-effective production factors; the widespread use of alternative energy sources and recycling energy; improving the quality and safety of raw materials and finished products
Methods and models of economic and mathematical software	Solving problems in the field of linear and dynamic programming: optimization of the mixtures and multi-component production cycles, transport and logistics facilities; application of valid models in the process of rationalization of the natural-economic balance
Processes of control and rationing of production indicators	Standard indicators of procurement, transportation, pre-processing, processing and reprocessing of raw materials and materials: the degree of resource utilization, conditional consumption, stock, output, price.
Natural resources and environment conservation	Intensification of the integrated use of raw materials, secondary resources, waste, intermediate components; loss and waste reduction; reduction of specific consumption and consumption rates

For a general understanding of the resource-saving process, it can be noted that this technology orients the production and sales of products (services) process to perform technological and trade operations with minimal costs at all stages of the life cycle. The degree of environmental impact should be minimal. It is also important to comply with the requirements for a full accounting of the primary material and labour components consumption during the entire production process, transportation and storage, referred to the unit of the finished product [2].

The analysis shows that the most important areas for improving the activities of meat production enterprises were and remain the reduction of direct and indirect production costs; adaptation and active use of resource-saving technologies; increasing the output of finished products from the unit of processed raw materials; production and product diversification; improving the quality of raw materials and finished products; manufacturing of packaged and packed products with high consumer properties and meeting the safety criteria; increasing the competitiveness of products and business entities; increasing integration and cooperation processes; formation of own raw material base; improving the technology of raising and slaughtering livestock; technical and technological modernization; adaptation and application of modern standards in the field of product quality management, technological process, and environmental management; solving problems of the shortage of highly qualified personnel; introduction of modern software systems for automation and robotization in the field of production, organization, planning, accounting and control; development of new market niches and expansion of distribution channels for finished meat products and semi-finished products.

Practical experience shows that the quality of raw materials and finished meat products

remains the most problematic issue. The lack of high-quality food at a reasonable price does not allow for the effective implementation of preventive measures to improve the quality of life, which is aggravated by the adverse environmental conditions [12, 18, 8, 9, 21].

In these circumstances, modern experts in the food industry, foodservice industry, and dietetics today are tasked to improve the structure of nutrition, including by improving the technologies for processing secondary raw materials and main production waste and creating new products with high nutritional and biological value, dietary and prophylactic purposes [17].

In our opinion, in solving this problem, especially in obtaining complete protein, much attention should be focused on the rational use of raw material potential and reserves of secondary resources, first of all, the reserves of the meat and dairy industry. The solution to this type of problem depends largely on the degree of development of low- and non-waste technologies. In this context, new methods of extracting animal protein from waste and meat-based secondary raw materials and their use in recipes of finished meat products are becoming highly significant.

The analysis showed that the leading foreign companies in the food industry today focused on the development of functional products, the use of secondary products, as well as special and health products based on traditional products. One of the most important and most valuable products of animal slaughtering is blood. Every year more than 500 thousand tons of this “by-product” is formed at sectoral enterprises. The total amount of rational use is less than 5%; however, there are a lot of options for using blood due to its chemical composition and properties [4]. At the same time, abroad, in the meat industry of the EU countries and the USA, the whole blood of animals, as well as all its components, are very successful. About 1/3 of the blood is used in the production of food products. Plasma and serum are mostly used. In particular, serum and plasma are used in the recipe of boiled sausages, chopped semi-finished products, dietetic products, and liver sausages [12]. The only problem with blood use is its colour, but today there are a significant number of ways to bleach it [8]. Thus, foreign meat-oriented enterprises are interested in the production of this raw material and do not allow the wasteful attitude to such a valuable by-product as blood [11].

In the context of the rational use of recycled food raw materials and food waste it is worth noting that on the basis of the All-Russian Scientific Research Institute of the Meat Industry (VNIIMP) named after V.M. Gorbатов highly efficient biotechnological solutions in the processing of cattle proventriculus followed obtaining fodder fortifier, dry vegetable and animal, vegetable and protein, and protein-carbohydrate feed (BUK) were developed.

In continuation of the study, we note that at St. Petersburg University of Low-Temperature Technologies a unique scheme has been developed for the processing of hard and soft wastes from meat production based on the use of safe food solvents. Note that the obtained organic mass can be dried on spray type plants at 200 ° C and get pure

protein in the form of a white dry powder. In the future, this food ingredient can be used in sausage production without any restrictions and improve the nutritional and biological value of meat products, which is an important competitive advantage in terms of import substitution and resource-saving strategies in the food industry [7].

Also in modern meat production, a sufficiently large amount of so-called fat mass is formed, which is quite widely used as the technical products in the production of technical products (feed meal).

Currently, VNIIMP has developed a method for utilization of flotation concentrate. As a result of applying this method, fodder fat of the 2nd or 3rd grade is obtained; all depends on the time when the processing of raw materials begins (after 10-12 hours, only technical fat of the 3rd grade can be produced). This method also makes it possible to produce high nutritional value from solid food waste.

Also, using a flotation cell, about 80% of fat and 75% of suspended solids can be extracted from wastewater containing fat, which is an important criterion in improving the environmental friendliness and wastelessness of meat production [3].

Further, we note that AnstaProInternational (USA) has successfully tested the developed technology for processing whole carcasses of dead and culled animals and poultry, as well as reprocessing hard and soft food waste based on the dry extrusion method. The basic initial technological condition for the application of this method is that the moisture content of the feedstock should not be higher than 40%. This produces a sterilized and stabilized animal feed. Grain and leguminous crops, oilcake, oilseed, and industrial oilseed products, and also bran are used as filler ingredients.

Recently, the microbial-enzymatic conversion methods for reprocessing meat waste generated after wastewater treatment are becoming more and more relevant and widespread. This method is based on the use of the biological product MicrozimWeightTrit developed by RSE-Trading LLC [11]. The main advantages of this technology include the fact that the fermentation process takes place without the formation of reactive gases and heavy volatile compounds; the mass of processed food waste is reduced by 50-70%. This preparation can be used for the process of deodorization of sewage sludge, aero tanks, silt detention ponds, solid waste storage tanks, and composting sites.

Also, the studies conducted by the State Research Institute "Sintezblok" proved the real possibility of processing sand and fatty sediments with the help of vermiculture (earth and manure worms, including California worms) into humus. This type of production can be organized on the basis of a sectoral enterprise with little or no organizational and operational costs.

Today, many authors have described scientific ways to improve the nutritional properties of low-grade raw meat and food waste of meat production based on lactic acid bacteria. Many other probiotic microorganisms are also used in this method. Among the most well-known drugs, it is worth highlight the following: "Bifidobakter", "Bacteria",

"Enterobiofidin", "Bifilak". These preparations are used for processing meat utilization waste and obtaining protein components for food, medical and cosmetic purposes [3, 12].

It is proved that anaerobic digestion is a very effective way of processing waste from meat production. In the course of application of this method, a precipitate is formed with a large number of nutrients that can be used in agricultural production as a mineral-organic fertilizer. This method of meat production waste processing is very effective and safe from the standpoint of hygiene and environmental friendliness, as it provides maximum waste disinfection.

Thus, the conducted studies have shown that resource-saving in the field of meat production has great potential, can provide a good incentive for improving the sustainability, efficiency, and competitiveness of sectoral enterprises and improve the quality of products. At the present stage, there are many approved scientific and technological solutions in the field of processing the edible processed raw materials and meat processing wastes, which require the close attention of the management structures of meat production enterprises and the support of state bodies and industry-specific production associations.

Accordingly, we conducted a pilot study in which one company used new and innovative methods of meat production and the other company used traditional methods of production. To make this comparison accurate, five indicators were considered: skilled and up-to-date workforce, new and up-to-date technologies, up-to-date information resources, up-to-date management and, finally, explicit savings mechanisms in different parts of the company (Table 2).

Table 2. Comparison of saving meat production with traditional and innovative methods

Indicators	Company No.1		Company No.2	
	Abundance	Percentage	Abundance	Percentage
skilled and up-to-date workforce	87	82%	17	16%
new and up-to-date technologies	14	64%	3	9%
up-to-date information resources	9	93%	2	18%
up-to-date management	12	77%	1	21%
explicit savings mechanisms	32	81%	4	4%
Meat production rate	15436 kg/day	82%	6436 kg/day	82%
Company monthly expenses	65135 USD/month	22%	1965135 USD/month	48%
Corporate income from by-products	USD43678 dollars/month	42%	1543 USD/month	6%

Table 2 shows that company No.1 has used new methods of meat production but company number two still continues the traditional way of producing meat. Based on the results, it shows that the No.1 Company produces almost half a day equal to the number two company meat. It has also been found that the company's costs are one-third of the company's number two, using the traditional method. Ultimately, it has been found that

using innovative, innovative meat production methods has boosted the number one earnings of the byproducts so that 42% of the company's total revenue is from the byproducts, while the number two is only 6% of its revenue comes from by-products.

5. CONCLUSION

It follows from the above that in the current market conditions the problem of increasing the resource efficiency level in the food industry and in particular at meat production enterprises is very important and relevant. Maintaining a focus on the advantages of high resource provision (availability of cheap labor; significant reserves of natural resources; lack of obvious competition in the aspect of this system of organization of the production process; lack of funds and interest of company management; low level of interaction and cooperation between production systems and scientific organizations; low indicators of approbation and assimilation of advanced technologies by enterprises in the field of innovative resource-saving) may have a negative synergistic effect on the stability and efficiency of functioning of the whole meat production, as well as the entire agro-industrial complex of the Russian Federation. In the end, all this can lead to significant social, economic and environmental tensions throughout the national economy. In these circumstances, a transition to a resource-saving innovative type of development in all industry segments of the agro-industrial complex is required. This approach should be based on such tools as scientific developments and knowledge, labour, technical and technological, innovation and investment, informational, organizational and managerial resources. All this, ultimately, will activate innovative solutions that are directly related to the priority role of developing a resource-saving mechanism and solving current social and economic problems of modern meat production.

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Professor Dr. Irina Bogomolova is Professor and Head of the Department of Management, organization of production and industry economy, Voronezh state University of engineering technologies (VSUIT), Russia. She has a Doctor of Economic Sciences degree. She is a Member of the academic Council of VSUIT, a member of the scientific and methodological Council of the University, Chairman of the editorial and publishing economic section, a member of the faculty of Economics and management. She is a co-executor of the grant "inter-Sectoral economic cooperation of enterprises (organizations) of grain products subcomplex in the conditions of modern agro-industrial policy" (NAO "Kazakh National Agrarian University"), the Republic of Kazakhstan.



Alexander Kotarev is an Associate Professor of the Department of Management and marketing in the Agroindustrial Complex, Voronezh State Agrarian University named after Emperor Peter I (Voronezh State Agrarian University), Russia. He is a Candidate of Economic Sciences He is the Head of the Center of Distance Educational Technologies of Voronezh State Agrarian University. His specialization is in International Business.



Dobrunova Alina I. is an Associate Professor at the Department of Economic Theory and Economics of Agriculture, Belgorod State Agricultural University named after V. Gorin. She is a Candidate of Sociological Sciences. She engaged in scientific activities with a focus on Management of Sustainable Rural Development.



Prostenko Alexander N. is an Associate Professor at the Department of Economic Theory and Economics of agriculture, Federal State Budgetary Educational Institution of Higher Education -Belgorod State Agricultural University named after V. Gorin, Russia. He is a Candidate of Economic Sciences. He holds the position of First Vice-Rector. He is an expert in the field of Economics and Management of Rural Development.



Dmitriy Chugay is an Associate Professor at the Department of Economic Theory and Economics of the Agro-Industrial Complex, Belgorod State Agrarian University named after V. Ya. Gorin, Russian Federation. He is a specialist in Economics and Management and an Expert in the Dairy-Productive Subcomplex.