**Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development**
**Vol. 24, Issue 1, 2024**
**PRINT ISSN 2284-7995, E-ISSN 2285-3952**

# CONCEPTUAL ASPECTS OF MANAGEMENT OF SUSTAINABLE DEVELOPMENT OF THE AGRIFOOD COMPLEX

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***Abstract***

*Stable development of agriculture in the context of innovative transformation of productive forces and structural changes is recognized as one of the directions of the National Security Strategy of the Russian Federation. Mechanisms for stimulating technological change and increasing efficiency should be aimed at achieving sustainable production criteria. The purpose of the study is to develop conceptual aspects of managing the sustainable development of agriculture using the example of livestock industries in conditions of structural transformation and technological changes. The article examines theoretical and methodological approaches to the study of problems of sustainable development of agriculture. An analysis was carried out and an assessment was made of the dynamics of crop yields and livestock production. Significant structural shifts and technological changes in the livestock subcomplex of Russia, caused by the processes of diffusion of innovations, have been identified. The authors have developed conceptual approaches to studying the problems of sustainable agricultural development in regional agricultural systems based on effective management. The main objectives of the proposed concepts are: expansion of production volumes of agricultural products, taking into account the needs of the region and export opportunities; technical and technological modernization of agricultural organizations and achieving an innovative balance of resources; compliance with the principles of rational environmental management and achieving environmental safety. The practical value of the results lies in the possibility of forming a strategy for the sustainable development of regional agricultural systems in the conditions of structural transformation and technological changes.*

***Key words*****:** *agri-food complex, livestock farming, innovation, technological change, sustainable development management*

## INTRODUCTION

The National Security Strategy of the Russian Federation has identified the achievement of sustainable development on a neo-industrial basis as the most important condition for the successful functioning of sectors of the agro-industrial complex [11]. To achieve this task, it is necessary to use effective forms and methods of stimulating the technological transformation of the agricultural sector and the rational use of production resources by agricultural enterprises. The purpose of the study is to develop conceptual provisions for the study of problems of managing sustainable development of agriculture using the example of livestock industries in the context of structural and technological changes. The article summarizes theoretical and methodological approaches to the study of problems of sustainable development of agriculture, and explores the main directions for improving the management of sustainable development.

Theoretical and methodological approaches to research on this topic are reflected in the works of D. Pearce, J. Pezzey, William E. Rees. David William Pearce, Edward Barbier and Anil Markandya viewed sustainable development as the ability of production not only to meet current needs, but also to plan for the needs of future generations. The fulfillment of this condition predetermines the need to reserve resources for future

production and introduce state control over the use of resources. Much attention in the study is paid to the problem of the impact of sustainable development on economic growth [19]. Sustainable development can be considered at the level of an individual enterprise, region, country, and also on a global scale. The Sustainable Development Goals, developed by the UN, contain recommendations for managing this process at the global level.

The implementation of the Goals largely depends on the flexibility, coordination, and maneuverability of existing national mechanisms for managing environmental and socio-economic processes [7].

J. Pezzey considered sustainable development both in a broad sense at the system level and at the level of a specific enterprise. The state must carry out the regulatory process by providing corrective subsidies to preserve non-renewable resources or by imposing taxes on inefficient management and deterioration of resources [20].

Ensuring the country's food security is largely determined by the efficient use of production resources in the agricultural sector and compliance with environmental safety. Agricultural issues of sustainable agricultural development are reflected in a number of works. For example, Bastan Mahdi used a system dynamics model to assess the level of sustainability of Iran's agriculture, noting the important role of organic farming and biological control. To reduce the consumption of water resources, it is recommended to repurpose the specialization of agricultural production [6].

The problems of increasing the efficiency of use of agricultural land are widely reflected in the scientific works of A. Popescu. Considering the features of land use in the countries of the European Union, the author emphasizes the need for a balanced ratio of production resources to obtain optimal results [21, 22].

Ali Sameh S explored the possibilities of using nanotechnology in agriculture, noting their undoubted advantages for increasing soil fertility and introducing soil protection measures, water purification and increasing stress resistance of plants. The author argued the effectiveness of using nanoelements in the technological process of production, processing and packaging of food products [2].

The problem of sustainable development in livestock farming is quite relevant, since the processes of concentration and intensification of production lead to an increase in greenhouse gas emissions [15].

According to expert estimates, food production accounts for over 30% of total greenhouse gas emissions caused by the use of pesticides, mineral and organic fertilizers [10].

Small-scale production is disproportionately affected by climate change. A sociological survey of representatives of small grain farmers in Central America showed that climate change has a negative impact on grain yields. Researchers point to the need to develop climate change adaptation programs to support small farmers, taking into account different socio-economic farming conditions [16].

A significant number of works are devoted to the study of the patterns of sustainable development of the agri-food complex of the country and regions. In her work, O. Cherednichenko substantiated the system of priorities for the sustainable development of the country’s agri-food complex and proposed measures for their implementation, using the results of a sociological survey of agribusiness representatives. Most experts highlighted the presence of such problems as climate change, limited resources for diversification of production, and rising costs of material and technical resources [9].

An important condition for compliance with the criteria for the sustainability of agricultural production is monitoring the condition of the soils of crop areas where organic products or agricultural products with improved characteristics are cultivated.

It has been proven that the production of products using new technologies helps reduce anthropogenic load. The federal budget should finance applied research programs on the problems of positive and negative externalities of using new technologies in agriculture. It is also necessary to allocate

financial resources from regional budgets to compensate for the costs of agricultural producers for soil research, as well as payment for consulting services on the selection and implementation of resource-saving technologies.

It is possible to introduce a flexible system of standards for land improvement, as well as soil protection from wind and water erosion for organizations with different sustainability criteria [4, 12].

In the livestock industry, it is especially important to comply with the maximum permissible concentration of production.

Similar problems of spatial development were considered in the work of P.A. Minakir [18].

An analysis of sectoral livestock programs in Russia revealed a discrepancy between the targets and long-term development criteria presented in the programs. Based on the calculations carried out for dairy cattle breeding, strategies for the development of livestock farming in regions with different levels of production concentration are substantiated [27].

In the previous works of the authors, the topic of sustainability of the agricultural sector was studied using the methodology of modeling the impact of innovation and investment development on economic growth in order to achieve food security.

Based on cluster analysis, groups of Russian regions with differences in the scale of production and export of food products, the level of production and export efficiency, and the availability of investment resources were identified.

Recommendations for stimulating innovation and investment activities with the aim of forming an export-oriented agricultural sector are substantiated. For the identified typological groups of regions, differentiated strategies for state regulation of sustainable development of agriculture have been proposed [24].

In modern conditions, research into trends and patterns of innovation processes in the agricultural sector is quite in demand. This work explores the problems of sustainable development of livestock industries in the context of structural changes and technological transformations.

The purpose of the study is to develop conceptual aspects of managing the sustainable development of agriculture using the example of livestock industries in conditions of structural transformation and technological changes

## MATERIALS AND METHODS

The theoretical and methodological basis of the study was the materials of the regulatory framework, the work of domestic and foreign scientists on the problems of development of the agro-industrial complex and its main sectors. To assess the process of diffusion of innovations in a spatiotemporal projection, the theories of technological discontinuity and diffusion of innovations were used. During the research process, monographic, abstract-logical, analytical, economic-statistical, and expert methods were used.

As an information base for the study, sources from Rosstat, line ministries, departments, business associations, materials from periodicals and expert assessments of specialists on the development of the livestock industry were used.

## RESULTS AND DISCUSSIONS

The sustainable development of the country's agricultural and food complex largely depends on the rate of economic growth, improvement of the functioning conditions of the rural environment, and compliance with environmental safety requirements. In Russia, agricultural areas are not used effectively enough, which is confirmed by statistical data on grain yields (Fig. 1).

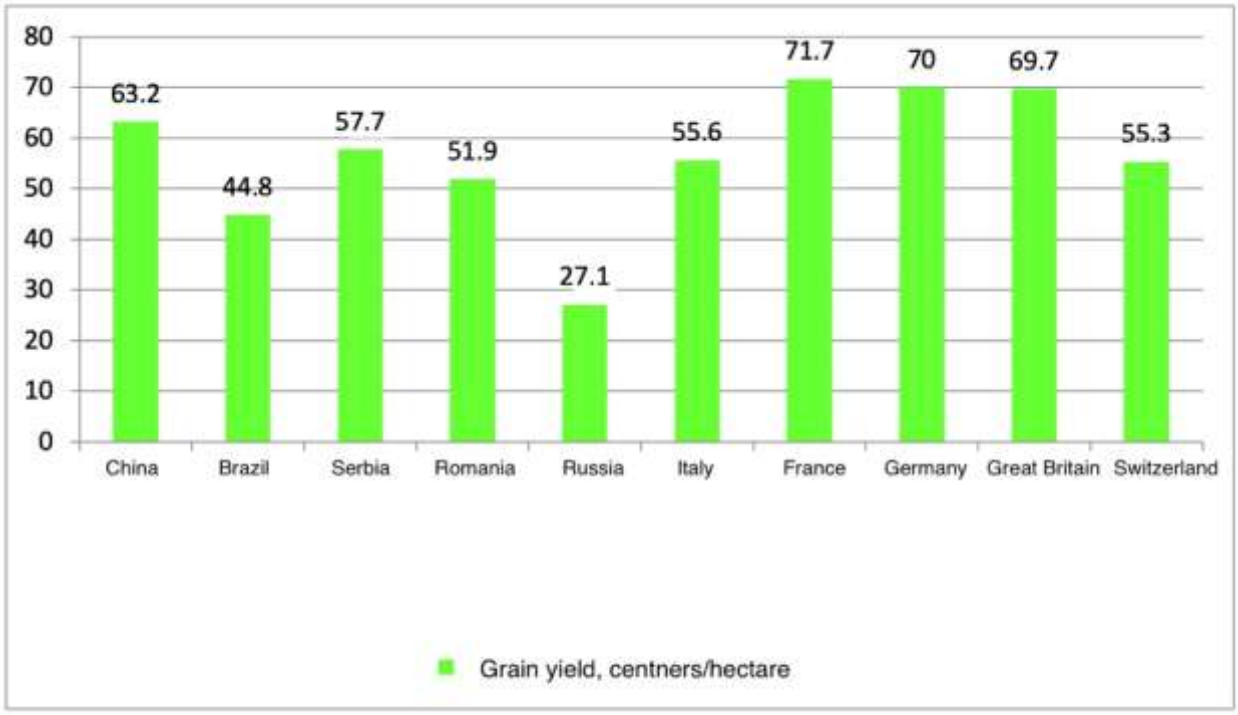


Fig. 1. Cross-country comparisons of grain yields
Source: Own calculations based on data [15].

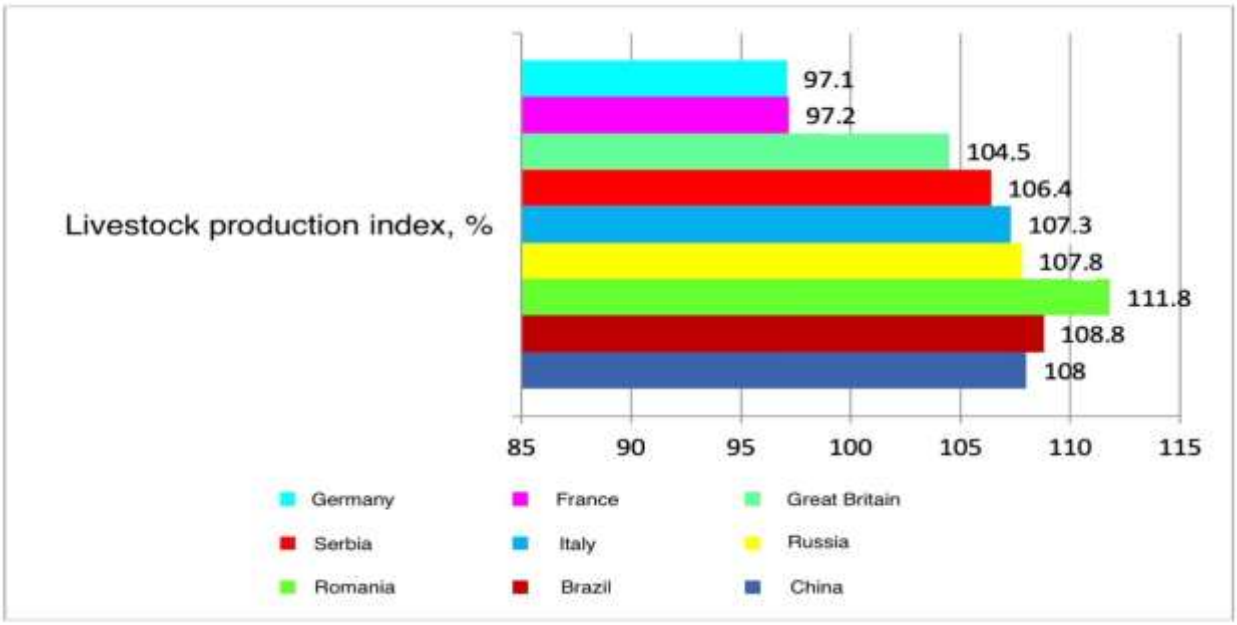


Fig. 2. Cross-country comparisons of growth rates in livestock production (2021 as a percentage of 2004-2006).
Source: Own calculations based on data [26].

A comparison of the dynamics of livestock production in individual countries of the world showed relatively high growth rates of Russian livestock production in 2021 compared to 2004-2006 (Fig.2).

A significant factor in increasing the volume of livestock production is the technological transformation of the industry. For 2017-2022 the innovative activity of organizations in the type of activity "livestock farming" has more than doubled. Large export-oriented organizations have a higher potential for the introduction and widespread use of innovative technologies. The problems of the low level of technological development of small-scale agriculture remain relevant for individual

Eastern European countries, as Popescu A. notes in his research [23].

In 2012-2022 There have been significant changes in the structure of meat production (Fig. 3).

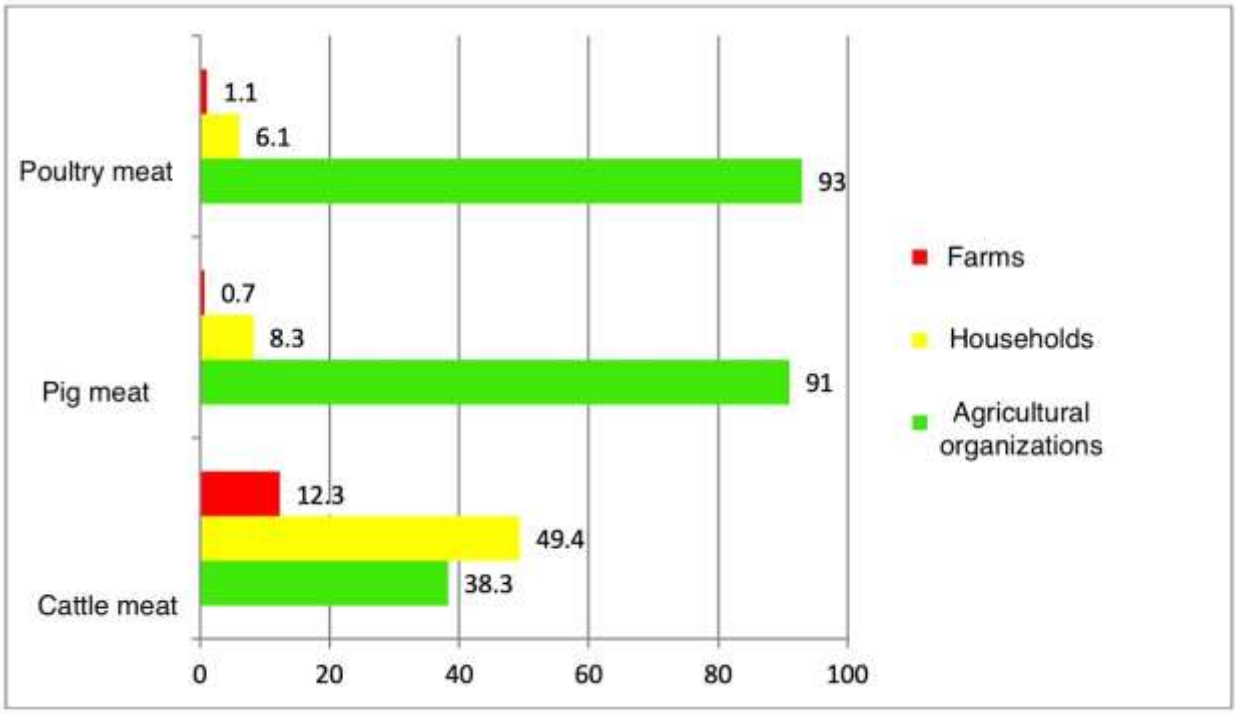


Fig. 3. Structure of meat production in Russia by farm category (2022).
Source: Own calculations based on data [8].

In 2022, the predominant share of pork and poultry production was accounted for by agricultural organizations and peasant (farm) farms. The development of pig farming on an industrial basis is explained by the rapid pace of modernization of production, as well as the development and implementation of new investment projects. The functioning of the industry is characterized by pronounced processes of business scaling: in 2022, the share of the twenty largest pig-breeding companies in the total volume of industrial pork production was about 80%. It should be noted that in terms of technical and technological development, these largest companies fully comply with international standards. The country has achieved complete self-sufficiency in pig meat; The task is to expand export positions. Increasing pork production volumes may result in increased competition in the domestic and global markets in the near future. Therefore, the most important tasks for the sustainable development of the industry are the formation of a breeding base and the construction of enterprises for slaughter and deep processing [17]. Along with achieving certain sustainability criteria, environmental problems have not been fully overcome.

In 2012-2022 In Russia, the concentration of pigs per unit of land area has increased. If in 2012 there were 78 heads per 1,000 hectares of agricultural land. pigs, then in 2022 - 124 goals. There is a need to increase the environmental responsibility of agribusiness enterprises using appropriate government regulation mechanisms [5]. In dairy farming, the impact of technological innovation on production efficiency is confirmed by a significant increase in cow productivity, which is especially typical for agricultural organizations; their share in total milk production is constantly increasing, which helps strengthen the innovative image of the industry. Along with the expansion of the agricultural sector in 2019-2022. there was a sharp increase in commercial milk resources (Fig. 4).

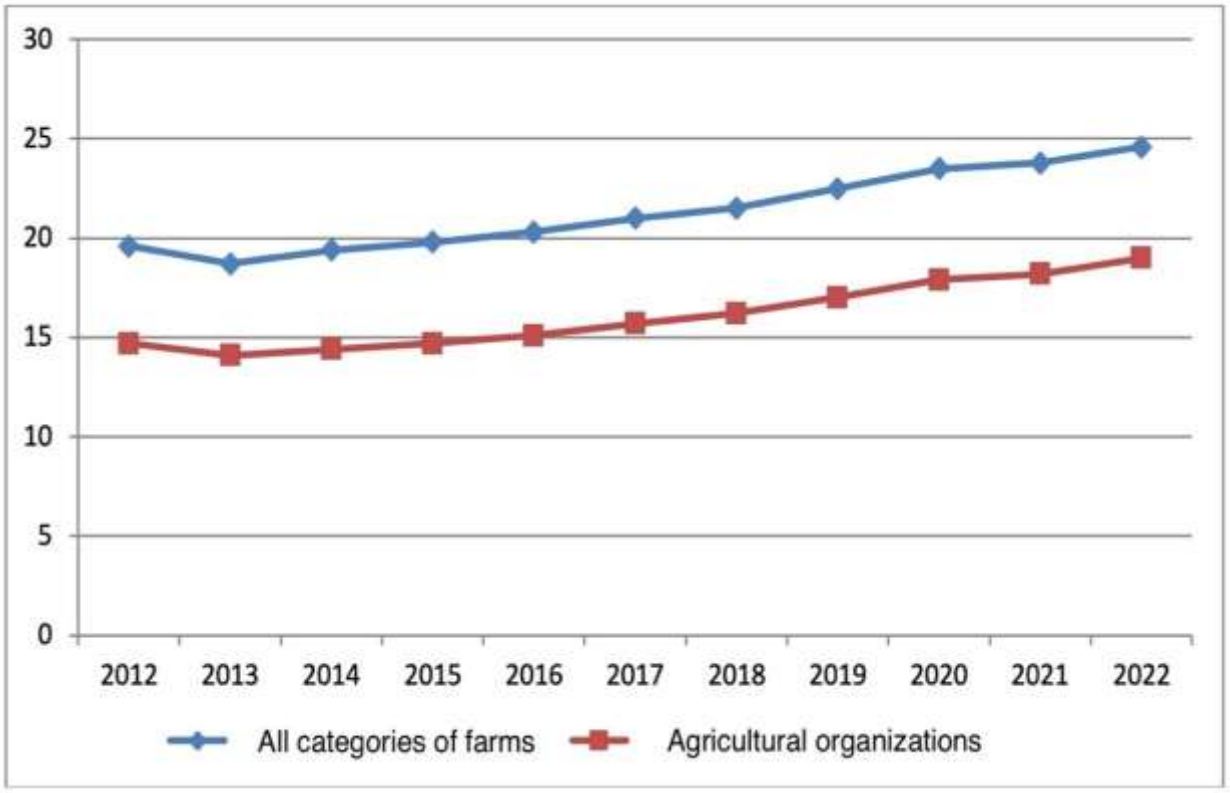


Fig. 4. Commodity milk resources in various categories of farms in Russia, million tons
Source: Own calculations based on data [1].

Increase in commercial milk volumes in 2018-2022. associated with increased government support and the introduction of new subsidies for the modernization of production. In 2023, additional measures were introduced to subsidize capital costs for the modernization of dry milk formula processing facilities; Part of the costs of product labeling is reimbursed. Further increase in the innovative potential of dairy cattle breeding is possible by improving selection and genetic work, maintaining feed balance and introducing advanced technologies for keeping cows. It is expected that the next stage of development of dairy farming will be influenced by the transfer of agricultural production to a fundamentally new technological basis. This will make it possible to build new patterns of interaction between participants in the innovation process and more actively use new technologies in small businesses.

The study showed that the processes of innovation diffusion have significant differences at the inter-industry and intra-industry levels. The relatively low rate of spread of technological innovations in dairy farming is explained by insufficient government support for small forms of farming. A similar point of view is expressed by R. Andergassen, Fr. Nardini, M. Ricottilli. When studying the process of diffusion of innovations, the authors proved the existence of an inverse relationship between the technological gap and the degree of diffusion of innovations, noting the need to use appropriate government regulation measures in order to reduce technological differences [3].

Overcoming differences in the technological level within groups of regions is possible by optimizing the structure of the volume of government support and developing appropriate mechanisms for increasing innovative potential. The most important area of stimulating innovative development of the agro-industrial complex is the creation of technological platforms [13,14].

Table 1. Conceptual approaches to managing sustainable development of regional agricultural systems

| | | | | |
|---|---|---|---|---|
| The goal of the concept is to manage the sustainable development of the agri-food complex in conditions of structural transformation and technological changes | | | | |
| Objectives of theconcept | | | | |
| Increasing the volume of agricultural products taking into account the needs of the region and export opportunities | Technical and technological modernization of agricultural organizations and achievement of innovative balance of resources | Formation of innovative personnel potential and development of new competencies by employees | Increasing the financial stability of agricultural organizations | Compliance with the principles of rational nature management and achieving ecological safety |
| Main activities of the concept | | | | |
| -Timely delivery to agricultural producers of funds from the federal budget and budgets of constituent entities of the Russian Federation allocated for the implementation of the activities of the State Program for the Development of Agriculture and Regulation of Markets for Agricultural Products, Raw Materials and Food | | | | |
| -Monitoring the condition of winter grain crops and the condition of perennial fruit and berry plantings | | | | |
| -Organization of work to increase the reliability of the level of forecast and actual production indicators provided to the Ministry of Agriculture of Russia and securing at the regional level personal responsibility for maintaining and filling out information systems of the Ministry of Agriculture of Russia | | | | |
| -Implementation of the supply plan for agricultural machinery and mineral fertilizers | | | | |
| -Financing of retraining programs and development of new specialties in accordance with the requirements of the digital economy | | | | |
| -Increasing the number of selection and seed-growing centers, forming a seed production plan | | | | |
| -Organization of planting and monitoring of seed crops | | | | |
| -Providing fire-fighting measures and preventing fires on agricultural lands | | | | |
| -Assessing the consequences of using new technologies and their impact on the environment in order to maintain the optimal level of production concentration | | | | |
| Expectedeffects | | | | |
| Economic (achieving food security in countries and creating an innovative segment of food exports) | Social (successful development of the rural environment and rural areas based on increasing the level of employment of the population and their development of new competencies) | Technological (the process of innovative resource substitution as a result of the use of advanced technologies and updating the material and technical base) | Institutional (improving state regulation of the process of disseminating innovations and increasing the profitability of agricultural producers) | Environmental (achieving positive spillover effects from the use of new technologies as a result of reducing anthropogenic load) |

Source: Own determination.

The formation of new technological foundations for the Russian agri-food complex predetermines the need to develop conceptual provisions for managing sustainable agricultural development at the regional level. The authors proposed methodological approaches to the formation of regional management concepts (Table 1).

The purpose of the proposed concept is to manage the sustainable development of the agri-food complex in conditions of structural transformation and technological changes.

The developed concept contains scientific approaches to managing the sustainable development of the Russian agri-food complex in the context of structural shifts and technological transformations. To achieve the country's food security, it is necessary to increase the volume of agricultural products, taking into account industrial and personal consumption, as well as export opportunities.

The presence of a significant technological gap between different categories of farms and the unsatisfactory state of the material and technical base predetermined the need to highlight the task of technical and technological modernization of agricultural organizations and achieve an innovative balance of resources.

Of great importance for the innovative transformation of the agro-industrial complex is the formation of the innovative potential of labor resources and their development of new competencies of the digital economy (third task).Improving the financial performance of agricultural organizations in the region is an indicator of the effectiveness of government support and indicates the possibility of more active implementation of technological innovations. The threat of environmental deterioration due to increased anthropogenic pressure makes it necessary to highlight the conceptual task of observing the principles of rational environmental management and achieving environmental safety.

## CONCLUSIONS

The study of the issues of sustainable development of agriculture in Russia was carried out on the basis of a study of theoretical and methodological approaches of scientists from the world community.

Based on cross-country comparisons and analysis of individual agricultural indicators, a conclusion was made about the sustainable pace of development of Russian livestock sectors and the need for more efficient use of agricultural land to increase grain yields.

Using the example of the Russian livestock subcomplex, an assessment was made of the compliance of its functioning with the principles of sustainable development. Structural shifts and technological changes, to a certain extent caused by the processes of diffusion of innovations, have been identified. At the intersectoral level, differentiation of innovative development is observed: an industrial sector has been formed in pig farming, and dairy farming is characterized by uneven innovative development.

A forecast assessment of meat production by type for the period up to 2030 was carried out. It is concluded that the transfer of agro-industrial production to a new technological basis in the conditions of the fourth industrial revolution will significantly increase the efficiency of using innovations in various categories of farms.

Problems of insufficient level of state support and innovative development of small agricultural business organizations have been identified, which requires strengthening state support and improving mechanisms for managing sustainable development.

The authors have developed conceptual approaches to managing the sustainable development of agriculture in the region. The main points are identified: increasing the volume of agricultural production, taking into account consumption and export opportunities; technical and technological modernization of agricultural organizations and achieving an innovative balance of resources; compliance with the principles of rational environmental management and achieving environmental safety.

## REFERENCES

[1]About resources and use of milk, http://komitet2-20.km.duma.gov.ru/upload/site2/document_news/028/314/497/1_Laykam___Resursy_i_ispolzovanie_moloka_gos.duma.pdf, Accessed on February 1, 2024.

[2]Ali, S.S., Al-Tohami, R., Koutra, E., Moawad, M.S., Kornaros, M., Mustafa, A.M., Mahmoud, Y. A.-G., Badr, A., Osman, M.E.H., Elsamahy, T., Jiao, H., Sun, J., 2021, Nanobiotechnological advancements in agriculture and food industry: Applications, nanotoxicity, and future perspectives, Science of the Total Environment, Vol. 792: 148359.

[3]Andergassen, R., Nardini, F., Ricottilli, M., 2017, Innovation diffusion, general purpose technologies and economic growth, Structural change and economic dynamics, Vol.40,72-80.

[4]Andryushchenko, S. A., 2022, Green food production as a direction for greening the agro-industrial complex, International Journal of Agriculture, Vol. 3 (387), 270-273.

[5]Andryushchenko, S. A., Vasilchenko, M. Ya.,2014, Resource opportunities for implementing an import substitution strategy, taking into account the environmental responsibility of agribusiness, Agricultural Scientific Journal, Vol.11: 75-80.

[6]Bastan, M., Khorshid-Doust, R.R., Sissi, S.D., Ahmahvand, A., et al., 2017, Sustainable development of agriculture: a system dynamics model, Kybernetes,Vol. 47 (1), 142-162.

[7]Biermann, F., Kanie, N., Kim, R. E., 2017, Global governance by goal-setting: the novel approach of the UN Sustainable Development Goals, Current Opinion in Environmental Sustainability, Vol.26: 26-31.

[8]Bulletin «Production of livestock products in the Russian Federation in 2022», rosstat.gov.ru, Accessed on February 1, 2024.
[9]Cherednichenko, O., Dovgotko, N., Rybasova, Y., Vorontsova, G., Momotova, O., 2022, Implementation of the UN sustainable development goals in the agri-food system of Russia: regional and sectoral features, International Journal of Sustainable Development & World Ecology, Vol.29 (6), 483-498.
[10]Crippa, M, Solazzo, E, Guizzardi, D, Monforti-Ferrario, F.,Tubiello, F.N., Leip, A., 2021., Food systems are responsiblefor a third of global anthropogenic GHG emissions. Nat Food, Vol. 2(3):198–209. http://www.nature.com/articles/s43016-021-00225-9, Accessed on February 3, 2024.
[11]Decree of the President of the Russian Federation of July 2, 2021 N 400 "On the National Security Strategy of the Russian Federation". http://government.ru/Accessed on February 1, 2024.
[12]Derunova E., Vasilchenko M., ShabanovV., Derunov V., 2021, Mechanisms to stimulate the acceleration of innovative development in the agroindustrialcomplex,Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 21(2):209–222.
[13]Derunova E.A., Vasilchenko M.Ya., Shabanov, V.L.,2021,Assessing the impact of innovation and investment activity on the formation of an export-oriented agricultural economy. Economic and Social Changes: Facts, Trends, Forecast, Vol. 14(5), 100–115. DOI: 10.15838/esc.2021.5.77.6
[14]Derunova, E., Kireeva, N., Pruschak, O., 2020, The level and quality of inclusive growth agri-food system in modern conditions. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.20(3),193-206.
[15]FAO, 2016, The role of livestock in sustainable agricultural development for food security and nutrition. Report of the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. fao.org›3/i5795r/i5795r.pdf, Accessed on February 3, 2024.
[16]Harvey, C. A., Saborio-Rodríguez, M., Martinez-Rodríguez, M. R., Viguera, B., Chain-Guadarrama, A., Vignola, R., Alpizar, F., 2018, Climate change impacts and adaptation among smallholder farmers in Central America, Agriculture & Food Security, Vol.7(1): 1-20.
[17]Kovalev, Yu, 2020, Pig breeding 2020: results of the year, plans, prospects. https://www.tsenovik.ru/articles/obzory-i-prognozy/svinovodstvo-2020-itogi-goda-plany-perspektivy. Accessed on February 1, 2024.
[18]Minakir, P.A., 2018, Spatial development strategy in the interior of concepts of spatial organization of the economy, Spatial Economics, Vol. 4: 8-20.
[19]Pearce, D., Barbier, E., Anil, M., 2013, Sustainable development: economics and environment in the Third World, Routledge. 230 p.
[20]Pezzey, J.,1992, Sustainable development concepts, World. Vol.1(1): 45.
[21]Popescu, A., 2018, Main aspects regarding the contribution of domestic trade to the development of Romania's economy in the period 2008-2017, Scientific Papers Series Management, Economic Engineering in culture and Rural Development Vol. 18(4): 250-259.
[22]Popescu, A., Dinu, T., Stoian., E., 2019, Efficiency of the agricultural land use in the European Union, Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 19(3): 475-486.
[23]Popescu, A.,2021, The Development of Agricultural Production in Romania in the Period 2010–2019 — a Statistical Approach, Annals of the Academy of Romanian Scientists Series on Agriculture, Silviculture and Veterinary Medicine Sciences, Vol.10 (1): 107–123.
[24]Shabanov, V. L., Vasilchenko, M. Y., Derunova, E. A., Potapov, A. P., 2021, Formation of an export-oriented agricultural economy and regional open innovations, Journal of Open Innovation: Technology, Market, and Complexity, Vol. 7(1), 32.
[25]The Global Economy.com, Grain yield per hectare - Classification of countries. https://ru.theglobaleconomy.com/rankings/cereal_yield/, Accessed on February 1, 2024.
[26]The Global Economy.com, Livestockproduction - Classification of countries. https://ru.theglobaleconomy.com/rankings/livestock_production_index/, Accessed on February 1, 2024.
[27]Vasilchenko, M.Ya., 2023, Problems of sustainable development of livestock sectors Regional agricultural systems: economics and sociology, Vol. 4, 66-73.