THE IMPORTANCE OF THE AGRICULTURAL SECTOR IN THE SYSTEM OF NATIONAL DEVELOPMENT AND ITS ROLE IN ACHIEVING THE GOALS OF SUSTAINABLE DEVELOPMENT

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Abstract. The purpose of the chapter is to provide a theoretical justification for an integrated approach to defining the essence of the agricultural sector as a complex system, taking into account its sectoral, institutional and systemic nature. The chapter analyses scientific approaches to interpreting the agricultural sector, particularly its role in the economy, structural characteristics, institutional environment, and interrelations with external and internal factors. Particular attention is paid to the identification of systemic properties of the agricultural sector that determine its ability to self-regulate, adapt to changes and sustainable development. The research methodology is based on an interdisciplinary approach that includes the concepts of agroeconomics, institutional economics, system analysis, and sustainable development. The paper uses analytical tools to study the dynamics of scientific interest in the agricultural sector, and its thematic and regional distribution in the global and national dimensions. The scientific novelty lies in the formulation of methodological foundations for understanding the agricultural sector as an integrated system operating in a transformational economy, global risks and challenges. The key areas for further research, in particular in the field of implementation of adaptive mechanisms for managing sustainable development, are identified. The conclusions emphasize that the formation of a comprehensive vision of the agricultural sector is a prerequisite for the development of effective agricultural policy and innovative development strategies.

Keywords: agricultural sector, integrated approach, sustainable development, institutional structure, system analysis, transformational changes, economic sustainability.

Relevance of the topic. The agricultural sector is a strategically important component of Ukraine's economy, accounting for a significant share of GDP, exports, and creating jobs, especially in rural areas. The reasons for this are the broad diversification of the industry, modern innovative technologies, and adapted experience in agri-food production. However, the significant transformational changes currently taking place in the global environment are causing uncertainty to intensify. The climate imbalance, the COVID-19 pandemic, and the full-scale invasion of Ukraine by the Russian Federation have had a direct impact on the domestic agri-food sector and generated increased risks and uncertainty. This is especially true of the impact of military actions that have led to significant labour migration, loss of significant areas of agricultural land and the inability to use them, including due to significant pollution, etc. The economic, social and environmental components have shifted from a process of sustainability and development to a process of transformation with a focus on stabilization. Under these conditions, improving mechanisms and tools to ensure sustainable development of the agricultural sector, taking into account the impact of uncertainty and transformational changes, is of particular relevance.

Analysis of recent research and publications. Studies by foreign scholars Alcaira S., Altieri M. A., Bowden R. J., Bowma Y., Bryan E., Vasa A., Wilbanks T. J., Wilson J., Gbetibuo G. A., Deressa T. T, Jones J.W., Cassman K., Cates R.W., Clerks L., Koufakan P., Kropf M.J., Liuis K., Meinzen-Dick R., Matzon P., Petreman A., Pilgrim S., Pretti J., Ringler K, Rossett PM, Seymour G, Sutherland WJ, Tillman D, Travis WR, Jimenez EG cover key methodological approaches to ensuring sustainable development of the agricultural sector in the face of economic, environmental and social risks and threats, analyze the possibilities of adapting agricultural systems to climate change. The problems of agricultural sector development, including ensuring its sustainability, are the subject of scientific works of such domestic researchers as: Andriychuk V., Borodina O., Danko Y., Ihnatenko V., Ilyash O., Kozak K., Kostetskyi Y., Krasnorutskyi O., Kupchyshina O., Letunovska N., Nifatova

O., Lyshenko M., Lupenko Y., Skydan O., Stoyanets N., Urba S., Kharchenko T., Yarmolenko Y. and others. Scientists are studying mechanisms for adapting national economic management systems and state support instruments to meet the requirements of sustainable development, economic security and long-term sustainability of the agricultural sector, emphasizing the importance of introducing digital innovations to increase the productivity and sustainability of agricultural production.

Identification of previously unresolved parts of the general problem to which this section is devoted. Despite the significant scientific achievements, a set of issues related to improving the theoretical and methodological foundations and practical implementation of mechanisms and tools for ensuring sustainable development of the agricultural sector, adapted to the conditions of uncertainty and transformational changes, requires further development. Particular attention should be paid to taking into account the relationship between external and internal factors, the effects of uncertainty affecting agricultural production, as well as the development of effective approaches to assessing the level of sustainable development both in general and in terms of economic, environmental and social components that form the analytical support for the implementation of adaptation mechanisms. The relevance of these issues determined the purpose, objectives and content of the study.

Summary of the main material. The agricultural sector is the basis of the country's food security, and it is closely linked to socio-economic dynamics and ecological balance. Accordingly, current research in this area is dominated by the imperative to increase its productivity while mitigating the adverse impact of anthropogenic activities on ecosystems, increasing resilience to climate threats and improving the social environment.

Despite a significant number of scientific developments in this area, we have found that there is no single approach to understanding the concept of "agrarian sector" in the context of ensuring its sustainable development in the scientific literature. In view of this, it is necessary to develop a theoretical basis for sustainable development of the agricultural sector, which requires defining the essence of the concept and its elements as objects of application of appropriate mechanisms and tools.

A significant contribution to the study of the theoretical and practical foundations of the functioning of the agricultural sector and the consideration of the categorical apparatus was made by such domestic and foreign scholars as Ihnatenko V. V. [1], Kozak K. B. [2], Kostetskyi Y. I. [3], Kupchyshina O. A. [4], Stoyanets N. V. [5], Urba S. I. [6], Kharchenko T. O. [7], Yarmolenko Y. O. . [8] and others. At the same time, despite the existence of a significant number of studies on this issue, it should be noted that the agricultural sector as an object of sustainable development is not sufficiently studied. Given this, we consider it appropriate to analyze approaches to the definition of this concept in the context of the research topic.

Approaches to interpreting this concept are presented in Table 1.1.

Table 1.1. *Sectoral approach to defining the concept of "agricultural sector" [compiled by the author on the basis of 3; 9; 10; 11; 12; 13; 14].*

Scientist	Type of activity	Features of the definition
Sector of economy		
Komarova I.	production of food or raw materials such as cotton or wood for domestic consumption or export	The approach focuses on the economic role of the sector (domestic consumption and exports)
Tsymbaliuk I., Rykovska L.	production of agricultural products and products of their primary processing	broad coverage and systematic nature, as it includes all agricultural producers and related service enterprises, as well as state agricultural policy
A set of industries		
Andriychuk V.	production, processing and storage and delivery of products made from agricultural raw materials to the end user	focus on the full production cycle and bringing products to the end user.
Goncharuk N.	production of food and raw materials for the processing industry	Emphasis on the interconnection of agriculture and processing industries (functionally related service units)
Kostetskyi Ya.	production of agricultural products, their industrial processing, storage and sale	Emphasis on an economically interconnected multi-sectoral structure. Focus on the production and technological division of labor in agriculture
U.S. Environmental Protection Agency	growing crops, raising animals, and catching fish and other animals on a farm, ranch, or in their natural habitats.	coverage of a wide range of activities without detailed analysis.
International Labor Organization	production and processing of agricultural crops, raising animals, as well as catching fish and other animals on farms or in their natural habitats.	
An integral national economic system of interconnected industries		
Mishchenko D.	production of agricultural raw materials and food, their procurement, storage, processing and sale to the public	Emphasis on integration and interconnection of different sectors into a single system
Part of the national economy		
Khorunzhyi M.	agricultural production	focus on basic production processes
Shulga O.	production of agricultural products and products of their primary processing	

The approach based on the concept of "sector of the economy" is fundamental for understanding the essence of the concept of "agricultural sector". The sectoral approach interprets the agricultural sector through the prism of production of specific products and emphasizes its contribution to the economy and employment.

The definitions presented in Table 1.1, despite the fact that some scholars do not use the term "sector of the economy" and consider the agricultural sector as a set of industries (Andriychuk V. G., Honcharuk N. T, Kostetskyi Y. I.) or as a part of the national economy or system (Mishchenko D. A., Komarova I. V., Tsymbaliuk I., Rykovska L., Khorunzhyi M., Shulga O. A.), they distinguish the agricultural sector on the basis of the activities or products that are specific to it. This is in line with the postulates of the sectoral approach, which emphasizes the economic and industrial role of the agricultural sector and segments it into separate industries (subsectors). The sectoral approach allows for a detailed study of the problems and opportunities in each of the branches of the agricultural sector, taking into account their specifics, and on this basis to introduce mechanisms and tools aimed at the unique needs and characteristics of different types of agricultural activities.

Regardless of how scientists use the sectoral approach to structure the agricultural sector internally and determine the relationships between them, this approach to studying the issues of

sustainable development is simplistic, since the agricultural sector does not arise as a result of a mechanical combination of individual components, but rather their complex interaction under the influence of a significant set of multidirectional factors.

In view of this, it is advisable to study the concept of "agricultural sector" based on the postulates of the institutional and systemic approaches, which allows for an integrative approach (Table 1.2).

The institutional approach emphasizes the important role of institutions, both formal and informal, that influence individual components of the agricultural sector.

Table 1.2. *Comparative Characteristics of Approaches to the Study of the Concept of "Agricultural Sector" [compiled by the author on the basis of 15; 16; 17; 18; 19; 20].*

	Sectoral	Institutional	Systemic
Focus.	Branches (subsectors) of the agricultural sector	institutions, rules and organizations that affect the agricultural sector	all interrelated components and relations in the agricultural sector
Key components	industries (subsectors) or types of activities	formal (legislation, public administration) and informal (defined by traditions, culture, habits and religion) institutions that have social, economic and political influence, which can be both restrictive and inclusive	the agricultural sector as an integrated system, including the entire value chain
Economic activity	economic activity in certain industries	Institutions that contribute to the efficient and sustainable functioning of the agricultural sector	economic activity in the agricultural sector as a system
Stakeholders	manufacturers, processors, distributors within certain industries	government agencies, financial institutions, market organizations, research institutions	all stakeholders involved in the agricultural value chain
Advantages.	detailed insight into the functioning of certain industries	Detailed understanding of governance, regulation and institutional support	full coverage of the complexity and interdependence in the agricultural sector as a system

Institutions in the most general sense encompass the laws, regulations, policies, norms and practices that collectively shape the operating environment of the agricultural sector. By focusing on them, the institutional approach emphasizes the importance of governance structures, regulatory frameworks, and support mechanisms for the agricultural sector as a whole and its sustainable development, and provides a detailed understanding of the mechanisms and frameworks that govern, regulate, and support the agricultural sector.

In turn, the study of the agricultural sector as a system is aimed at determining how its state is influenced by the relations between individual subsystems, taking into account the nonlinear interactions between them and the fact that these interactions cause feedbacks that are the basis of self-regulation and emergent qualities of complex systems, and generate synergistic effects.

Having summarized the developments of scientists in this area, we have identified the following systemic properties of the agricultural sector that should be taken into account when ensuring sustainable development:

– Structured. The agricultural sector has an internal complex structure formed of many subsystems that are subordinated to common goals and at the same time have their own unique properties, distributed horizontally and across hierarchical levels or non-hierarchically, which creates conditions for the formation and movement of resources of various types. In its turn, any subsystem

of the agricultural sector can be viewed as a relatively independent system consisting of lower-order subsystems;

– emergence, which is determined by the identification of "a new productive force or qualitatively new sources of development of increasing the efficiency of activities as a result of combining individual parts, elements, factors into a single system due to the so-called system effect. ... that is, the presence of ... properties that are not inherent in its individual element, which is considered outside the system" [15];

– sustainability that arises in the agricultural sector as a result of numerous social, environmental, economic, and physical interactions within it and in interaction with the external environment [21];

– Determinism by unique spatial (both objective physical, such as in the case of a farm, and subjective) and temporal (short-term and long-term) boundaries determined by the structure of the environment, socio-economic and political structures, and land use decisions made by producers;

– the dynamism of systemic processes, which has different scales and speeds. During fundamental management transformations, such as the transition from conventional to organic farming, the rate of change of processes can be rapid, while natural processes, such as changes in the total amount of organic carbon in the soil due to land use changes, can be slow;

– system openness, which means that resources and information constantly cross system boundaries. Quantifying the net flows between subsystems, as well as into and out of systems, is important for understanding the movement and consequences of these processes and properties, including sustainability;

– interaction with the external environment. The agrarian sector forms and manifests its properties in the process of interaction with the external environment, being a leading component of this influence. Accordingly, its study requires determining the characteristics of the external environment in which it operates and taking into account its impact on the effectiveness of mechanisms and tools for ensuring sustainable development;

– functionality. In agroecosystems, structural properties (e.g., soil type, climate, biodiversity) determine functions such as plant productivity, nitrogen retention, or greenhouse gas emissions, as well as emerging properties such as efficiency, resilience, and sustainability. The relationship between structure and function provides a useful framework for designing agricultural systems to optimize specific functions or to understand the basis of differences between agroecosystems.

Thus, based on the above, we believe that the agricultural sector as an object of research should be considered in an integrated manner (Fig. 1.1), combining sectoral, systemic and institutional approaches, distinguishing between the micro level (the agricultural sector in terms of the components that form it) and the macro level (the agricultural sector as a system with its inherent systemic properties).

All components are closely interconnected and form an integral system of the agricultural sector. Inputs are used by actors in the production process through the value chain. Products, in turn, are the result of these processes and can again influence inputs and actors through feedback, for example, in the form of profits reinvested in improved inputs and technologies.

The integrated approach allows for a multidimensional analysis that takes into account the roles of institutions, the specifics of agricultural sectors, and interrelationships within the system, and forms a methodological basis for promoting sustainable development of the agricultural sector.

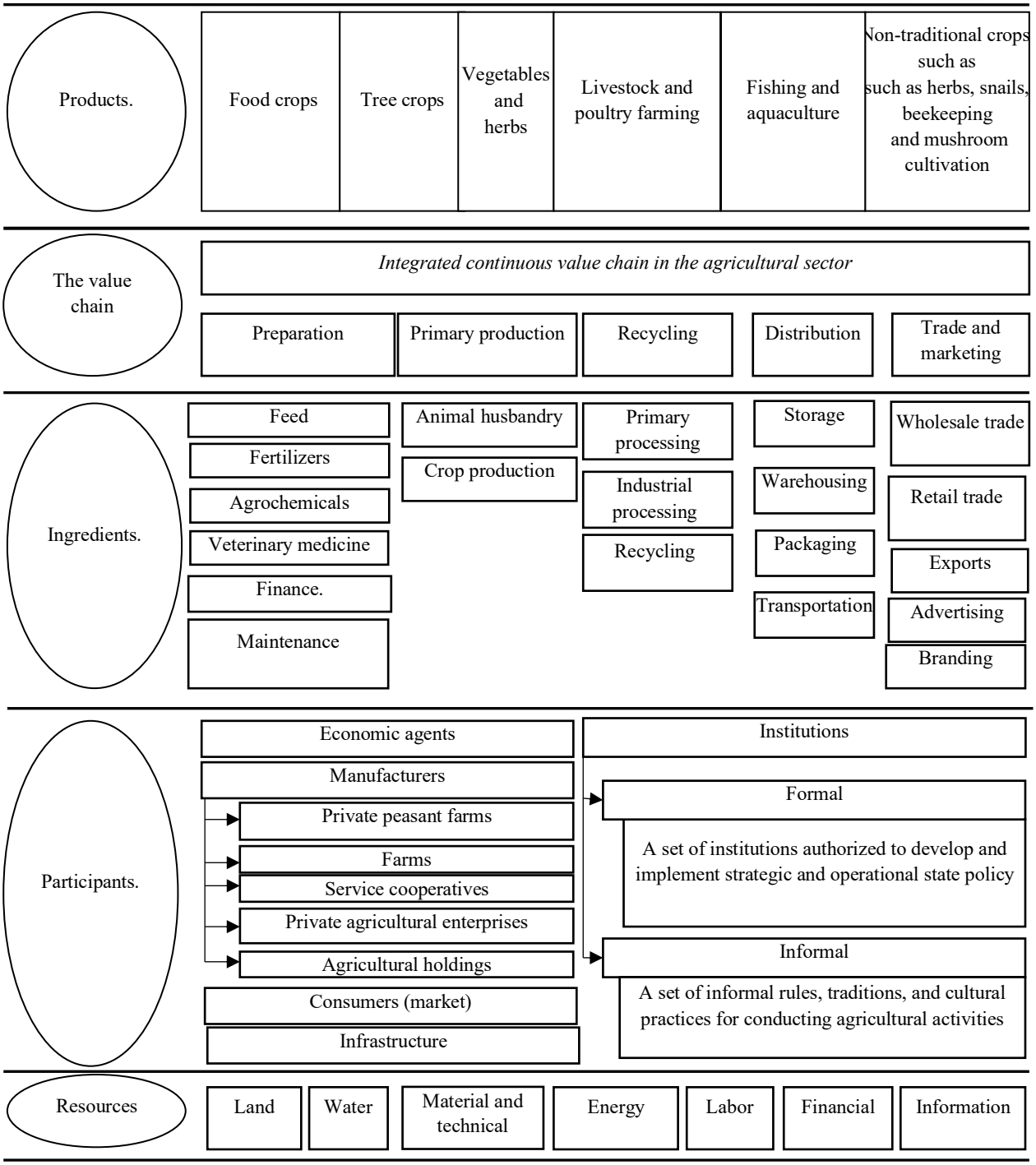

Fig. 1.1. *Structure of the agricultural sector according to the integrated approach*
Source: summarized by the author

This is due to the fact that sustainable development requires balanced economic growth, environmental protection, and social welfare. The institutional approach ensures that the public administration system and the regulatory framework are aligned with the goals of sustainable development.

The sectoral perspective allows for targeted interventions that increase the sustainability of specific agricultural practices at the level of individual components of the agricultural sector. The systems perspective ensures that sustainability is considered throughout the value chain and that interdependencies and feedback loops within the agricultural sector are managed and controlled to

prevent negative effects. In addition, the systems approach takes into account the complex interactions between different subsystems, including environmental, economic, and social, and assesses how changes in one part of the system can affect others.

An important element of the study of the agricultural sector is the study of the dynamics of scientific interest in this area (Fig. 1.2).

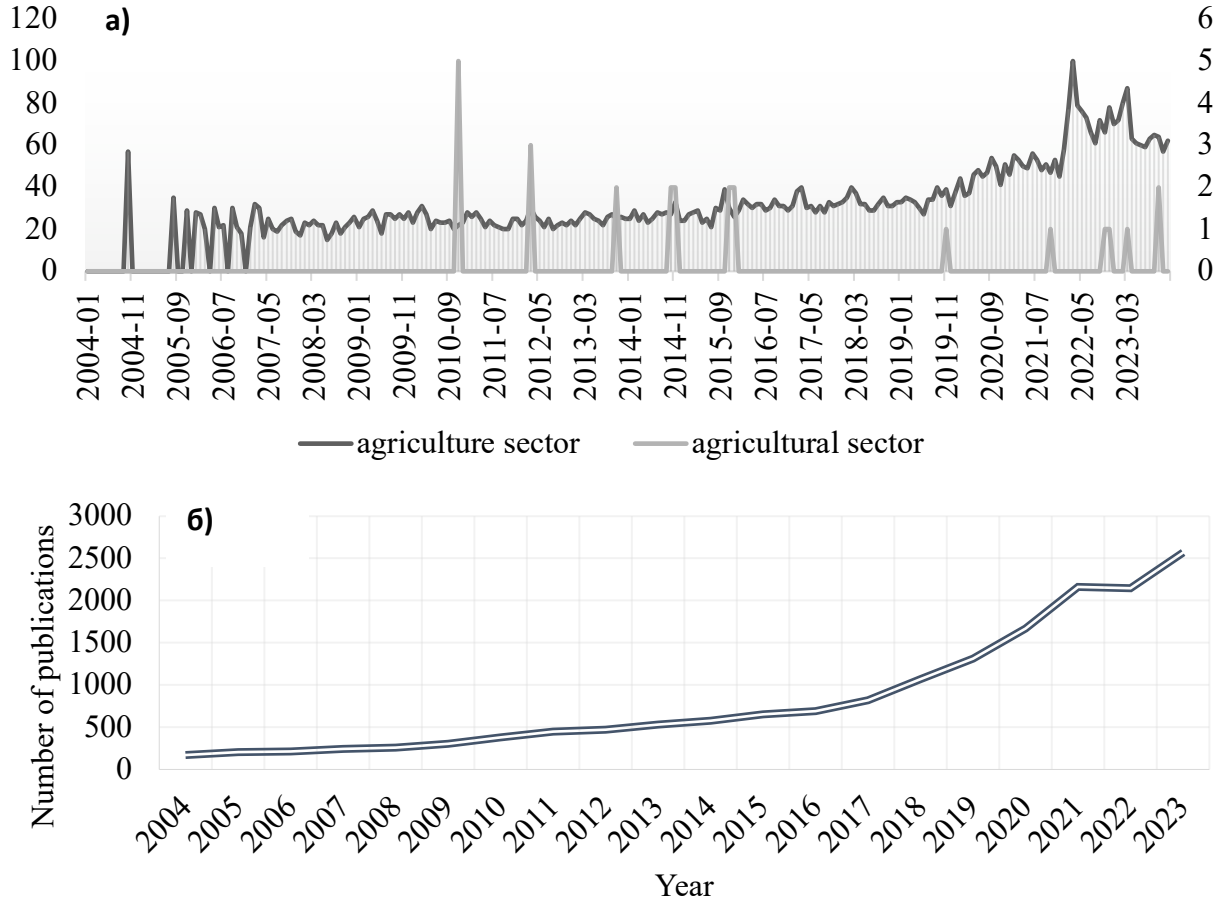

Fig. 1.2. *Comparison of the dynamics of search queries on Google on the agricultural sector (a) and scientific publications in the SCOPUS scientometric database on the same topic (b) for 2004-2023.*
Source: created by the author

The results of the trend analysis based on the dynamics of publications in the international scientometric database SCOPUS and Google Trends, presented at in Figure 1.2, allow us to conclude that this topic is actively studied and arouses both scientific and user interest.

The Google Trends data presented in Figure 1.2a characterizes the interest in the concept of "agricultural sector" for the period from 2004 to 2023. It is important to note that Google Trends values are relative and are measured in the range from 0 to 100, where 100 means the peak of the concept's popularity.

During 2004-2017, the interest in the concept of "agricultural sector" fluctuates, with small ups and downs, is rather low and stable, with small increases in certain periods. In 2018-2023, there is a certain increase in interest, especially in 2020-2022, with a peak in 2022. In the Ukrainian-language segment of the Internet, there was no or very little interest in this topic during the analysis period, with minor spikes in certain months. This may indicate a limited interest in the concept in the Ukrainian-speaking environment compared to the English-speaking one.

Figure 1.2 b shows a gradual increase in documents in the agricultural sector from 2004 to 2010 (average growth rate of 11%), accelerated growth from 2011 to 2017 (average growth rate of 15%), and intensive growth since 2018 (average growth rate of 18%). The period of 2019-2023 is a period of high interest and activity in the industry, primarily due to threats to food safety as a result of the COVID-19 pandemic and Russia's full-scale war against Ukraine.

Thus, based on the above, we can conclude that in 2004-2023, three periods can be distinguished in the dynamics of agricultural research:

– In this period, the number of scientific publications has been growing gradually. The overall interest in the term on the Internet remains stable and relatively low;

– The period 2014-2018 saw a gradual increase in the number of scientific publications and relatively stable interest with small increases without a sharp rise in the Internet;

– In this period, there is a clear correlation between the growth of scientific publications and interest in the agricultural sector on the Internet. This confirms the increased interest in the topic among both scientists and the general public, primarily caused by threats to food security as a result of the COVID-19 pandemic and Russia's military aggression.

The distribution of research in the agricultural sector by industry (Figure 1.3) characterizes the diversity of problems and challenges faced by modern agriculture.

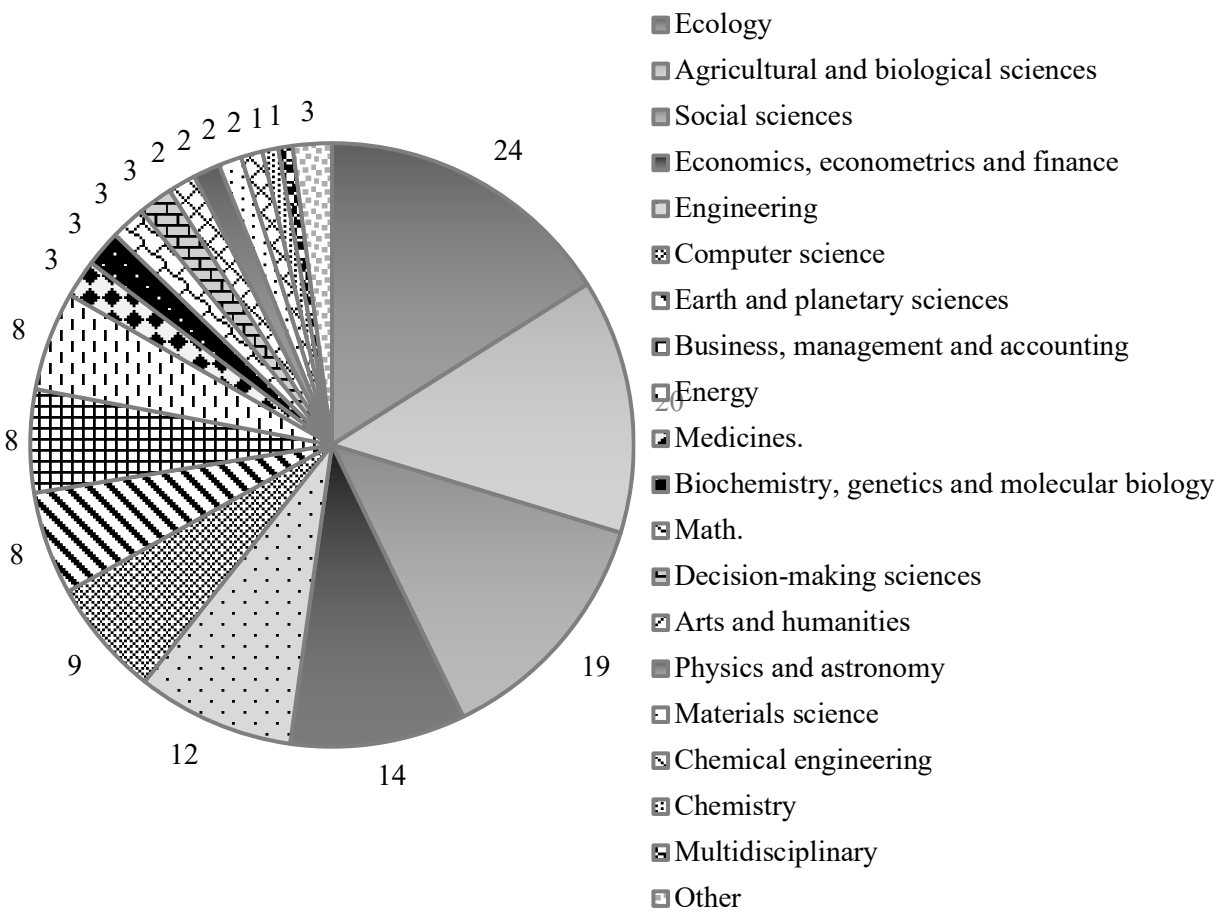

Fig. 1.3. *Structure of the sectoral affiliation of scientific publications on the agricultural sector indexed in the SCOPUS scientometric database for 2004-2023.*
Source: created by the author

Most of the research is conducted in the field of ecology (24%), agricultural and biological sciences (20%), and social sciences (19%). This emphasizes the importance of sustainable development and environmental aspects, efficiency gains based on biological aspects of production, and a strong focus on socio-economic aspects, including rural development, social aspects of land use, and food security.

Research in economics, econometrics and finance (14%) focuses on key economic aspects, including adaptation to market trends, business analysis and risk management.

The growth of publications in engineering (12%) and computer science (9%) demonstrates the importance of integrating modern technologies into agricultural production, including information technologies, through the development of precision agriculture, big data analysis, and the use of artificial intelligence to optimize production processes, increase their productivity and efficiency.

The category "Business, Management and Accounting" (8%) covers research on the management of agricultural enterprises, strategic planning and efficiency of business processes.

Research in the energy sector (8%) focuses on renewable energy sources, bioenergy, and energy management in the agricultural sector.

The Earth and Planetary Sciences area (8%) covers geological and climatic research, which is important for understanding crop growing conditions and managing natural resources.

Research in the agricultural sector is global in nature, covering all regions of the world (Figure 1.4). On a regional basis, research on the agricultural sector is concentrated in Asia (41% of all publications), due to the significant contribution of India (1952 publications), China (1086 publications), and Indonesia (837 publications). This reflects the importance of this sector for the economies of these countries and their efforts to solve agricultural problems specific to each country. European countries, primarily Italy (828 publications), Germany (820 publications), and the United Kingdom (755 publications), also make a significant contribution to the development of agricultural sciences (34% of all publications), focusing on research on achieving sustainable development goals, climate risks, and innovations in the agricultural sector.

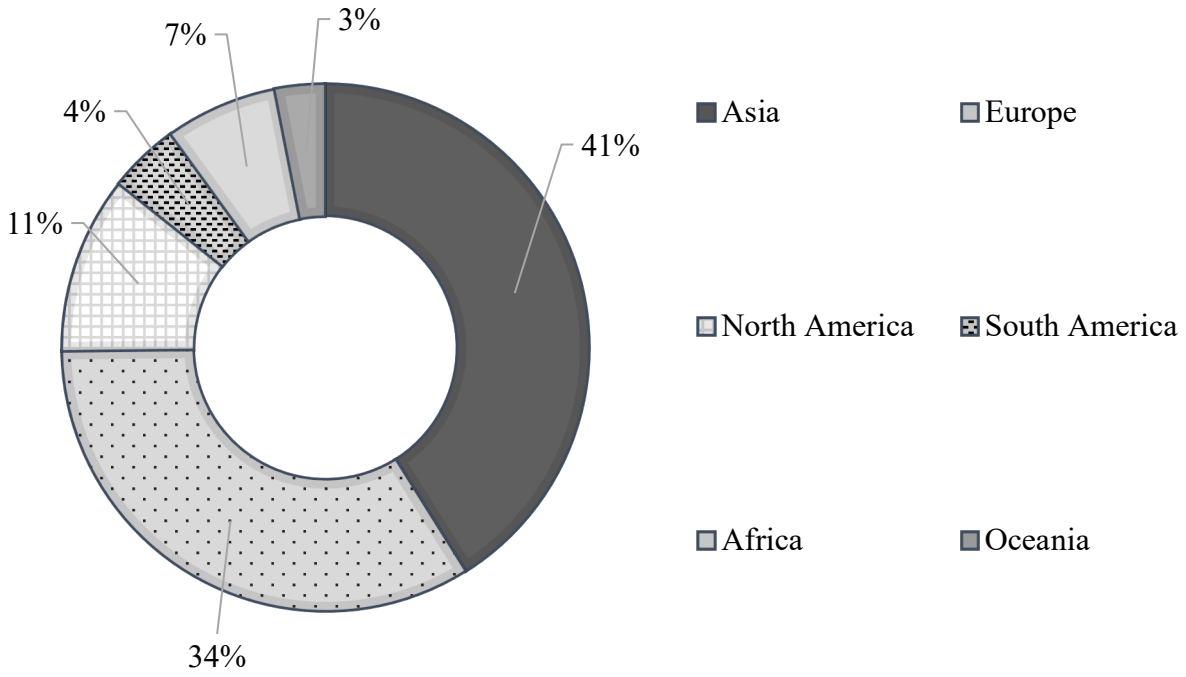

Fig. 1.4. *The structure of regional affiliation of scientific publications on the agricultural sector indexed in the SCOPUS scientometric database for 2004-2023.*
Source: created by the author

In Ukraine, publication activity in the agricultural sector also demonstrates a significant level, as reflected in 483 scientific publications since 2004. The main areas of research in this field in Ukraine cover a wide range of topics that are critical for the development of agriculture and related industries, including ensuring the sustainability of agricultural production, reducing the environmental burden and introducing environmentally friendly technologies, developing effective models of agricultural enterprise management, and introducing new technologies in agriculture, including IT solutions, automation and robotization of agricultural processes.

Research in North America (11% of publications) is concentrated mainly in the United States (1714 publications) and Canada (384 publications). The United States is one of the world leaders in this field, focusing research on genetic modification of plants and animals, precision agriculture, and the development of new technologies to increase productivity and conserve all types of natural resources. Research in the agricultural sector in Canada (2%) focuses on climate change adaptation, achieving sustainable development goals, and innovative technologies in agriculture.

The publication activity in the agricultural sector in South America (4%) reflects the diversity of climatic conditions and crops grown in the region. Countries such as Brazil (445 publications), Argentina (102 publications), Colombia (182 publications), and Chile (97 publications) demonstrate a strong interest in research aimed at solving specific agricultural problems relevant to their conditions, primarily involving increasing the sustainability of the agricultural sector, introducing innovations, and increasing productivity.

The African continent has a relatively low level of publication activity, focusing on improving productivity, implementing sustainable agricultural practices and ensuring food security, biodiversity conservation and optimal management of natural resources, which are key aspects of agricultural sector development in the region. The largest number of scientific publications is currently observed in South Africa (434 publications) and Nigeria (306 publications).

Australia (543 publications) and New Zealand (124 publications) are the main countries with publication activity in Oceania (3% of publications). Australian scientists focus on the study of adaptation mechanisms to climate change and the effective management of all types of natural resources. Researchers from New Zealand focus on a wide range of areas in the agricultural sector in accordance with the priority sectors of agriculture, in order to improve their productivity, efficiency and sustainability, ensuring high quality products and minimal environmental impact.

According to Google Trends, the greatest interest in the topic of the agricultural sector is shown in developing countries belonging to Africa (Liberia, Malawi, Rwanda, Tanzania, Zambia, Zimbabwe, Ethiopia, Uganda, Ghana) and Oceania (Fiji, Papua New Guinea). For the vast majority of them, the agricultural sector is the backbone of the economy, the main source of employment and livelihood for a large part of the population. This explains the high interest in issues related to agriculture, food security, and environmental aspects. These countries, however, do not demonstrate a high level of publication activity in this area, which may be due to limited resources for research and a less developed scientific infrastructure.

Thus, summarizing the above, we can conclude that the relevance of research in the agricultural sector is constantly growing and reflects a wide range of scientific interests and research areas that vary depending on regional conditions (the level of economic development of the country and the role of the agricultural sector in GDP formation; peculiarities of natural and climatic conditions that determine the specifics of the agricultural sector) and needs.

At the next stage, we will summarize the scientific results obtained by foreign and domestic scholars in the agricultural sector of economic direction, systematizing research in the social sciences, economics, econometrics and finance, and business, management and accounting.

During the period of analysis, foreign scientists published 6805 papers with dynamics that corresponded to the general trends in the dynamics of research in the agricultural sector (Fig. 1.5).

Based on the results of the keywords systematization, we have identified the following groups of priority research conducted by foreign scientists in the agricultural sector.

Research in the group of general agricultural topics (keywords: "agriculture" (1332 references), "agricultural production" (340 references), "agricultural development" (207 references), "farming system" (152 references), "crop production" (143 references), "agricultural land" (132 references), "agricultural market" (92 mentions), "food production" (90 mentions), "agricultural workers" (87 mentions), "livestock" (46 mentions)) cover key elements of agricultural business activities, including the production and marketing of agricultural products.

The results obtained by the scientists form the basis for effective management of agricultural resources and contribute to the sustainable development of the agricultural sector, which is critical for ensuring food security and economic growth at the regional and national levels.

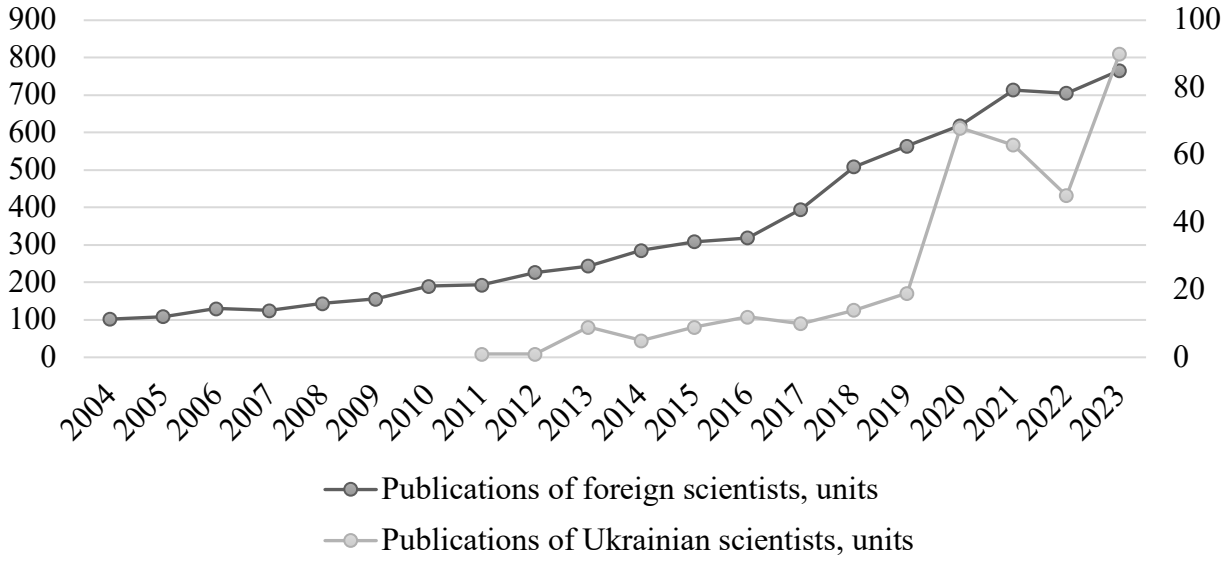

Fig. 1.5. *Dynamics of scientific publications in the SCOPUS scientometric database on the issues of the agricultural sector for 2004-2023*.*

Example: TITLE-ABS-KEY ("agricultural sector") AND (LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "ECON") OR LIMIT-TO (SUBJAREA, "BUSI")

Source: created by the author

The second group of studies (keywords: "agrarian policy" (211 references), "common agricultural policy, CAP" (101 references), "environmental policy" (68 references), "policy development" (60 references), "state policy" (44 references), "state support" (8 references), "state regulation" (8 references)) focuses on state regulation of the agricultural sector and covers the issues of development and implementation of state policy, regulation and management of the agricultural sector. They contribute to the development of effective strategies and mechanisms of public administration of the agricultural sector aimed at increasing its competitiveness and ensuring food security of the country, as well as achieving the Sustainable Development Goals.

The next group of studies focuses on the economic aspects of the agricultural sector (keywords: "economic growth" (211 references), "economic development" (130 references), "economic impact" (57 references), "economic analysis" (62 references), "economic and social impact" (69 references), "agricultural economics" (158 references), "rural development" (169 references), "competitiveness" (97 references), "investment" (104 references), "income" (72 references), "agricultural management" (53 references), "income distribution" (46 references), "poverty alleviation" (43 references)).

The role of the agricultural sector in economic development is considered by scholars in two aspects. First, researchers analyze the impact of the agricultural sector on economic growth and

economic development. In this context, special attention is paid to the role of the agricultural sector in developing economies in terms of its contribution to GDP, poverty reduction, and improvement of socio-economic conditions in these countries. Secondly, scientists are actively analyzing the impact of the agricultural sector on rural development, the income of the population employed in the agricultural sector, and their distribution in the context of ensuring socio-economic equality.

An important area of research is the study of economic aspects of managing agricultural enterprises at the micro level, including the analysis of market trends, introduction of innovations, effective investment and marketing strategies.

Thus, research in this area is important for understanding how economic mechanisms and instruments affect the agricultural sector and, conversely, how it contributes to economic growth and development. These studies help to identify effective strategies to increase the competitiveness of the agricultural sector, improve the economic condition of rural areas and ensure sustainable development.

The next group combines studies of the impact of the introduction of new technologies, including the use of machine learning methods, robots and automated systems, biotechnology, genetic engineering and nanotechnology, new methods of soil cultivation, seed production and animal husbandry, on increasing its productivity and efficiency (keywords: "agricultural robots" (118 mentions), "agricultural technologies" (80 mentions), "technology implementation" (57 mentions), "information management" (48 mentions), "machine learning" (41 mentions)). This topic also includes studies that analyze the processes of introducing new technologies in the agricultural sector, including the study of factors that facilitate or hinder the introduction of innovations, economic aspects of technology adoption, and the issue of adaptation of producers to new technologies.

Thus, studies of the impact of technologization and digitalization in the agricultural sector are important for understanding how modern technologies and innovative approaches can increase its productivity and efficiency. They help to identify key areas of technology development that can significantly improve the quality and quantity of agricultural products produced, as well as contribute to the sustainable development of the agricultural sector.

Much of the research focuses on the impact of climate change on the agricultural sector and its resilience, food security, and the environmental impacts of agricultural activities. They emphasize environmental aspects that are crucial for the long-term sustainable development of the agricultural sector. Key aspects of research in this area are the study of:

– the effects of climate change on agricultural production, adaptation strategies of producers and mechanisms of adaptation to new climatic conditions (keywords: "climate change" (440 mentions), "climate impact" (57 mentions));

– sustainable development issues (keywords: "sustainability" (296 mentions), "sustainable development" (295 mentions));

– factors that affect the availability and access to food, as well as the search for ways to ensure the stability of food security (keywords: "food security" (291 mentions));

– methods of management and rational use of water resources in the agricultural sector, including irrigation issues (keywords: "water management" (117 mentions), "water resources" (117 mentions), "irrigation" (116 mentions), "water conservation" (47 mentions), "drought" (60 mentions), "water supply" (63 mentions));

– the impact of agricultural activities on the environment, including soil and water pollution and emissions of harmful substances (keywords: "environmental impact" (76 mentions), greenhouse gases (150 mentions), "carbon dioxide" (61 mentions), "carbon emissions" (47 mentions), "deforestation" (41 mentions)).

Research in this area is key to understanding the mechanisms of sustainable development of the agricultural sector, as it helps to identify strategies for its adaptation and reduction of vulnerability to climate change, and is aimed at ensuring environmentally sustainable and sustainable development.

A separate group of scientific publications addresses specific issues and challenges of the agricultural sector in different regions of the world, such as China, India, the European Union, Africa, the United States, and others. This allows us to take into account regional peculiarities and contexts when designing policies and development strategies to ensure sustainable growth.

Table 1.3 summarizes the most influential publications of foreign scholars in the agricultural sector based on the number of citations.

Table 1.3. *The most cited publications of foreign scientists by the keyword "agricultural sector" indexed by the SCOPUS database for 2004-2023 [compiled by the author on the basis of 22; 23; 24; 25; 26; 27; 28; 29; 30; 31].*

Author(s).	Title of the publication	Content of the publication	Number of citations
O'Donnell K.J., Rao D.S.P., Battese G.E.	Meta-frontal framework for studying efficiency and technological coefficients at the firm level	**Analysis of technological efficiency** Conclusions: Technological efficiency analysis methods, such as meta-frontal frameworks, allow comparing the efficiency of firms operating in different technological conditions, which is important for assessing productivity and identifying technological gaps between countries. Recommendations: expand the use of meta-frontal methods to analyze the efficiency of various industries.	995
Bryan E., Deresa T.T., Gbetibuo G.A., Ringler K.	Climate change adaptation in Ethiopia and South Africa: options and constraints	**Adaptation to climate change** Conclusions: Effective strategies to adapt the agricultural sector to climate change are essential to protecting livelihoods and ensuring food security in Africa. Recommendations: develop and implement adaptation strategies that take into account local conditions and specifics of farms to increase their resilience to climate change.	789
Alkir S. and others	Women's Empowerment Index in Agriculture	**Empowering women in rural areas** Conclusions: The Women's Agricultural Empowerment Index is an important tool for measuring gender equality and developing policies that promote women's integration into the agricultural sector. Recommendations: use the index in different countries to monitor and evaluate progress in gender equality in rural communities.	540
Flerke M., Schneider K., McDonald R.I.	Competition for water between cities and agriculture caused by climate change and urban growth	**Water resources management** Conclusions: Increasing the efficiency of water use in the agricultural sector as a basis for ensuring urban water security in the face of growing demand and climate change. Recommendations: integration of water management with a focus on improving the efficiency of water use in the agricultural sector for sustainable urban development.	476
Donaldson D., Hornbeck R.	Railroads and American Economic Growth: A Market Access Approach	**Historical quantification of the impact of railroads on the US agricultural sector** Conclusions: Railroads have had a significant impact on the US agricultural sector, helping to increase market access and productivity. Recommendations: Analyze the historical development of transport infrastructure and its impact on current agricultural practices and policies to optimize logistics and distribution.	475
Gutman J.	Neoliberalism and the development of food policy in California	**Agricultural policy** Conclusions: The impact of neoliberal policies on agricultural activities and food policies in California emphasizes the importance of understanding the economic and political contexts for the development of the agricultural sector. Recommendations: Critical analysis of political and economic approaches that influence agricultural policy to develop effective strategies to support the agricultural sector.	419

Klerks L., Leuwis K.	Creating and implementing innovation brokers at different levels of the innovation system: the experience of the Dutch agricultural sector	**Agricultural market infrastructure** Conclusions: Innovation brokers play an important role in introducing innovations in the agricultural sector, but face difficulties in perceiving their value. Recommendations: Raising awareness of the role of innovation brokers and supporting their activities by creating favorable conditions for the development of innovation infrastructure.	391
Pretti J. et al.	Top 100 issues important for the future of global agriculture	**Priorities of the global agricultural sector.** Conclusions: Identification of the 100 most important issues for the global agricultural sector based on a horizontal scan with the participation of experts and representatives of large agricultural organizations. Recommendations: use to set priorities for agricultural research and support state policy in the agricultural sector	389
Srbinovskaya M., Gavrovsky S., Dimtsev V., Krkoleva A., Borozan V.	Monitoring of environmental parameters in precision agriculture using wireless sensor networks	**Precision farming.** Conclusions: the use of wireless sensor networks to monitor environmental parameters in greenhouses contributes to the efficiency of precision agriculture. Recommendations: integration of modern monitoring technologies into agricultural production to optimize growing conditions and increase productivity.	388
Asfau A., Simane B., Hassen A., Bantider A.	Variability **and** trend analysis of time series of precipitation and temperature in north-central Ethiopia	**Analysis of climate change.** Conclusions: The analysis of precipitation and temperature in the context of climate change is important for developing adaptation strategies in the agricultural sector. Recommendations: Strategies developed in the agricultural sector should take into account the decline and instability of precipitation and the upward trend in temperature.	381

Thus, the generalization of scientific research by foreign scientists emphasizes the importance of an integrated approach to research in the agricultural sector, including the development of methodological foundations for agricultural production, taking into account the introduction of modern technologies and digitalization, and taking into account the political context, environmental aspects, and social factors.

During the period of analysis, 348 articles were published in Ukraine in the subject areas of Social Sciences, Economics, Econometrics and Finance, and Business, Management and Accounting with the keyword "agricultural sector".

Based on Figure 1.4, we can conclude that the first scientific publication on this topic appeared in 2011. From 2011 to 2019, the number of publications grew at a moderate pace, reaching 19 in 2019. Since 2020, the number of publications has been growing at a significant pace, reaching 90 in 2023, which is the highest figure for the entire period. This confirms the stable interest and activity of Ukrainian scientists in research related to the agricultural sector.

The analysis of publications of Ukrainian scientists in the agricultural sector presented in the SCOPUS scientometric database for the period 2004-2023 allowed us to identify the most common keywords that characterize the priority research areas.

Based on the most frequent keywords, it can be determined that researchers are actively engaged in studying a wide range of issues related to the structure and organization of agricultural enterprises, the development of the agro-industrial complex and the production of agricultural products (keywords: "agriculture" (69 mentions), "agricultural production" (16 mentions), "agricultural products" (9 mentions), "agricultural production" (2 mentions)).

Like foreign scholars, domestic scholars study the interrelationships of the agricultural sector with environmental aspects (keywords: greening (2 mentions)) and climate change (3 mentions) and climate effects (5 mentions), its impact on the environment (keywords: "environmental impact" (3 mentions), "environmental protection" (3 mentions)). Another important area is the study of food

safety (25 references), sustainable development (24 references) and sustainable agriculture (3 references).

The research of Ukrainian scientists also covers the role of innovation and technological developments in the agricultural sector, including digitalization (7 references), digital transformation and digital technologies (2 references each), and the introduction of innovative technologies and technological development (3 references each). The main focus of the research is on how technological advances and innovations can increase the productivity and efficiency of the agricultural sector.

Key words such as "state support" (8 mentions), "state regulation" (11 mentions), "agrarian policy" (6 mentions), "state financial support" (3 mentions), "state agrarian policy" (3 mentions) indicate that the mechanisms of state intervention in the development of the agricultural sector, including financial support strategies, are actively being researched, which are key factors for ensuring stable and efficient development of the Ukrainian agricultural sector in the current difficult operating environment.

Economic research focuses on such aspects of the agricultural sector as ensuring economic growth (keywords: "economic growth" (5 mentions), "economic development" (4 mentions), "agricultural economics" (158 mentions)).

The impact of investments is actively studied (keywords: "investments" (22 references), "investment activity" (4 references), "investment attractiveness" (4 references), "capital investments" (5 references), financing (6 references) and financial support (8 references)) on the state and development of the agricultural sector.

In Ukrainian research, considerable attention is paid to improving analytical tools to ensure the effective functioning of the agricultural sector (keywords: "economic-mathematical model" (2 references), "economic-mathematical modeling" (2 references), "economic analysis" (5 references)).

Unlike foreign scholars, Ukrainian researchers pay considerable attention to the study of issues related to the economic security of the agricultural sector (7 references).

The keywords "export," "international trade," and "export quotas" demonstrate the interest of researchers in the issues of agricultural exports and the functioning of agricultural markets in the context of developing Ukraine's export potential and studying market mechanisms.

Table 1.4 summarizes the most influential publications of Ukrainian scientists in the agricultural sector based on the number of citations.

The data presented in Table 1.4 confirm the wide range of research in the agricultural sector of Ukraine, covering issues both at the macroeconomic level (in terms of promoting sustainable development in the structure of the national economy, state incentives for agricultural production) and at the microeconomic level in the field of agricultural enterprises' development based on innovative development, reputational risk management, and ensuring profitability and competitiveness.

Based on the results of the study, we have drawn the following conclusions.

The dynamics of publications in the agricultural sector over the period of analysis is upward, with the largest volume of scientific publications in the SCOPUS scientometric database over the past five years, and these trends were characteristic of both foreign and domestic scientists.

It should be emphasized that foreign studies are characterized by great diversity and detail, covering a wide range of aspects of the agricultural sector.

Table 1.4. *The most cited publications of Ukrainian scientists by the keyword "agricultural sector" indexed in the SCOPUS scientometric database for 2004-2023 [compiled by the author on the basis of 32; 33; 34; 35; 36; 37; 38; 39; 40; 41]*

Author(s).	Title of the publication	Content of the publication	Number of citations
Lyuliev O, Pimonenko T., Stoyanets N., Letunovska M.	Sustainable development of the agricultural sector: the influence of democratic profile among developing countries	**Sustainable development** Conclusions: The level of democracy has a statistically significant impact on the sustainable development of the agricultural sector and food security. Recommendations: Strengthening democratic institutions will contribute to more effective achievement of sustainable development goals in the agricultural sector, especially in developing countries	66
Evdokimov Y., Chygryn O., Pimonenko T, Lyuliev O.	Biogas as an alternative energy resource for Ukrainian companies: EU experience	**Alternative energy** Conclusions: The analysis of the prerequisites for the development of the biogas market in Ukraine has shown significant potential for the use of biogas plants. Recommendations: Implementation of European experience in the use of biogas and development of incentive mechanisms for investment in alternative energy in Ukraine.	54
Kozlovsky S. Mazur G, Vdovenko N., Shepel T, Kozlovsky V.	Modeling and Forecasting the Level of State Stimulation of Agricultural Production in Ukraine based on the theory of fuzzy logic	**Modeling of state incentives** Conclusions: models have been developed using the theory of fuzzy logic to predict the level of economic and administrative incentives for agricultural production in Ukraine. Recommendations: expediency of using models to formulate strategies for state support of the agricultural sector and increase its efficiency	26
Trusova N. and others	Innovative Development and Competitiveness of Agribusinesses in the System of Ensuring Economic Security of Ukrainian Regions	**Economic security** Conclusions: the expediency of a comprehensive assessment of the innovative development of agrarian business in Ukraine in the context of economic security based on the determination of their determinants and the impact of competitiveness of agrarian business entities. Recommendations: Promote innovation in the agricultural sector by supporting research and introducing the latest technologies into production.	19
Zakharchenko O, Eremin A**.,** Ushakov D., Odintsov O, Melnychenko S.	Reputational Risk Management in Agricultural Enterprises of Eastern Europe as a Component of Increasing Their Competitiveness	**Reputational risks** Conclusions: the article develops an algorithm for managing reputational risks based on the methodology of their assessment and takes into account the peculiarities of management in agricultural enterprises of post-Soviet countries of Eastern Europe. Recommendations: use of the methodology for assessing and managing reputational risks to increase the sustainability of agricultural enterprises.	18
Pushak Y., Lagodienko V., Basiurkina N., Nemchenko V., Lagodienko N.	Formation of a system for assessing the economic security of an agricultural enterprise	**Economic security** Conclusions: a model for assessing the level of economic security of an agro-industrial enterprise based on an integral indicator has been developed Recommendations: use of the indicator to ensure the stable functioning of agricultural enterprises.	13

Yatsenko O, Nitsenko V., Karasova N., James H. S, Purcell J.L.	Realizing the potential of the EU-Ukraine Free Trade Area in agriculture	**Export potential** Conclusions: Identification of promising trends in the development of the export potential of the Ukrainian agricultural sector, taking into account the potential negative consequences of highly competitive markets based on the gravity model Recommendations: develop strategies to optimize agricultural exports and adapt to highly competitive EU markets.	13
Shahini E., Korzhenivska N., Haibura I., Niskhodovska O., Bala I.	Problems of profitability of agricultural production in Ukraine (2023)	**Profitability of agricultural production** Conclusions: analysis of the profitability of agricultural production by types and yields of crops and regions under the negative impact of martial law Recommendations: Develop comprehensive measures to support the profitability of agricultural enterprises, including through government programs and investments.	12
Lupenko Y., Khodakivska O., Nechyporenko O., Shpykuliak O.	The state and trends of agriculture in the structure of the national economy of Ukraine (2022)	**Innovative technologies** Conclusions: Identification of promising vectors for the development of the agricultural sector, including the introduction of bio- and nanotechnologies and various types of genetic developments. Recommendations: implementation of European principles of regulation and organization of the agricultural sector.	12

They focus on topics such as general agriculture (1,332 studies), agricultural production (340), agricultural development (207), and farming systems (152).

In addition, significant attention is paid to crop production (143), agricultural land use (132), agricultural markets (92), and food production (90). These studies are aimed at ensuring the efficiency and sustainability of the agricultural sector, addressing various aspects from production to marketing and management.

Ukrainian general studies, although less numerous, also focus on key areas such as agriculture (69), food security (25), and sustainable development (24). They are aimed at addressing the current problems of the country's agricultural sector, with a particular focus on governance (19), agricultural enterprises (18), and agricultural production (16).

Foreign studies cover agrarian and environmental policy issues in greater depth, paying significant attention to agricultural policy (211), general agricultural policy (101), policy development (60), and environmental policy (68). These studies focus on analyzing and improving public administration mechanisms and tools to promote sustainable development of the agricultural sector, taking into account environmental and social aspects.

Ukrainian studies are more focused on agricultural policy (6), state support (8), and state regulation (8), in particular in the context of the state budget (4). They are aimed at improving public governance and support for the agricultural sector, ensuring efficient use of resources and sustainable development of the sector, taking into account national peculiarities.

Foreign studies cover a wide range of economic issues, from economic growth (211) and development (130) to rural development (169) and agricultural economics (158). Studies also include issues of competitiveness (97), land use (94), and impacts on the economy (57), including income distribution (46) and socioeconomic conditions (43).

In contrast to foreign studies, Ukrainian research is more focused on investment (11), competitiveness (12) and economic security (7). Particular attention is paid to efficiency (13), development (13) and financial resources (3), with efforts to support the stable economic development of the agricultural sector in the face of current challenges.

Foreign studies also focus on innovation (152), agricultural robots (118), and technology (80). They also cover the adoption of innovative technologies (57), big data (56), and technical efficiency (50), looking at modern technological approaches to improving the productivity and efficiency of the agricultural sector.

Ukrainian studies also pay attention to innovation (9) and digitalization (7), although to a lesser extent. They are aimed at introducing the latest technologies and innovations to improve the efficiency of the agricultural sector, taking into account the specifics of Ukrainian realities.

In terms of environmental aspects, foreign studies are more extensive and detailed, covering climate change (440), sustainable development (295), water management (117), and irrigation (116). They also address environmental impacts (76), greenhouse gas emissions (72), and environmental protection (41), with a focus on ensuring the environmental sustainability of the agricultural sector.

Unlike foreign studies, Ukrainian research focuses on specific aspects, such as biomass (3) and greening (2), aiming to address environmental issues that are relevant to Ukraine.

Foreign studies have a broad geographical focus, including studies in different regions of the world, such as China (233), India (187), the European Union (161), Eurasia (140), and Africa (126). They cover specific issues of agricultural sector development in different contexts and regions, analyzing regional specificities and challenges.

Ukrainian studies focus mainly on Ukraine's hinterland (9) and integration with the EU (2), addressing state regulation (3) and specific regional challenges. They are aimed at improving regional development and integration into the European space.

Conclusions from this study and prospects for further research in this area. The generalization of theoretical and methodological approaches to the analysis of the agricultural sector allows us to assert that its sustainable development in the context of transformational instability requires a comprehensive and integrative approach to research. The agricultural sector is not only a production unit of the economy, but also a complex multilevel system with numerous interconnections covering economic, environmental, social and institutional dimensions.

The analysis shows that the most productive approach to studying the agricultural sector is to integrate sectoral, systemic and institutional approaches. This combination allows to cover the structural and functional features of the sector, to take into account the impact of external factors, to determine the role and importance of formal and informal institutions in shaping an adaptive environment for sustainable development.

The identified systemic properties of the agricultural sector (structuredness, emergence, sustainability, dynamism, openness, interaction with the environment, functionality) allow for a deeper understanding of the complexity of interrelationships within the agricultural system, as well as its ability to adapt, self-regulate and innovate. This, in turn, is the basis for the development of effective public policy mechanisms and management tools.

The analysis of the dynamics of scientific interest in agricultural issues confirms its high relevance in the context of global challenges such as climate change, pandemics, and military conflicts, which especially exacerbates the need to transform approaches to managing the sector. Publication activity in this area has increased significantly, indicating that the scientific basis for strategic changes is being intensively developed.

The systematization of research in the field of agricultural economics has identified a number of priority areas: ensuring food security, adapting to climate change, introducing digital technologies, strengthening the role of agricultural policy, developing investment attractiveness, and improving the efficiency of agricultural enterprise management.

Particular attention should be paid to the role of Ukraine in this context: the scientific community is increasingly active in researching the agricultural sector, focusing on the challenges caused by the war and finding ways to restore and sustainably develop the country's agricultural potential.

Thus, further research should be focused on developing innovative models of the agricultural sector, taking into account system analysis, spatial specificity, current risks and prospects for sustainable development, which will ensure its sustainability, efficiency and competitiveness in the medium and long term.

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