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Concept of locating crop production with minimal adverse impact on the environment

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ABSTRACT
Sustainable development of agriculture based on organic production technologies aims to preserve the environment and the quality of soil and water resources. It requires a conceptual systems approach to ensure the effective use of available production resources, including natural conditions. The presented work aims to develop the optimal location of organic agriculture across the territory. The basis of the concept is a methodological approach to the typification of territories, taking into account a set of factors, implemented in a developed information system that allows us to visualize the results of typification in the form of an interactive map, easy to use for producers and consumers of organic products, consulting, and financial organizations. Using induction and deduction methods, unique statistical methods (factor and cluster analysis, calculation of aggregate indicators), and software products made it possible to solve the following problems: Proposing a determination of the optimal location of organic products; developing a system of statistical indicators that comprehensively characterize production conditions; clustering large and small territorial units; visualizing the results obtained; and developing an online calculator to calculate an organization's carbon footprint. The proposed concept has a high potential for application in countries with a large territorial extent and different levels of development. The results of using the information system as the basis of the concept can be useful for producers in the agricultural sector, agricultural management bodies, national and international organizations that accumulate, process and disseminate information about organic agriculture, and educational and research organizations.

Keywords: Organic agriculture, Typification, Information system, Interactive map, Online calculator, Indicator system, Database.
Article type: Perspective.

INTRODUCTION
The environment ensures life on the planet and the possibility of the existence of future generations; preserving its condition is the most important task for humanity. Environmental issues occur in all countries, regardless of the level of development and geographical location, which are associated primarily with the impact of human activities, including air, water, soil pollution, forest destruction, and fertile layer destruction. This leads to significant global warming, i.e., climate change, and consequently to a reduction in biodiversity and an increase in disasters that destroy biogeocenosis. While providing the nutritional needs of people and industries with the necessary resources, agriculture also causes significant damage to the environment. Agriculture is the largest source of carbon dioxide, nitrous oxide, ammonia, nitrite, and phosphate pollution emissions. The processes of intensification of production in the agricultural sector, which took place in the 50s-70s of the last century, made it possible to increase production volumes to meet the needs for food and raw materials and increase labor productivity and living standards in rural areas. At the same time, the accumulation of harmful substances and the destruction of the fertile layer have now raised the issue of finding solutions for conservation technologies in

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agriculture. Organic agriculture is one of the most obvious solutions to achieve the goals set in the United Nations global call set out in the UN Decade on Ecosystem Restoration (2021-2030) to conserve existing biological systems and restore ecosystems worldwide to achieve global sustainable development goals. Also, organic resource-saving technologies are consistent with the low-carbon development strategy until 2050, presented by Russia at the COP26 conference in Glasgow (RBC 2021). At the same time, implementing energy transformation will require investments in "green" projects of about 1% of GDP. Indeed, new approaches to production, particularly organic crop production and livestock farming, involve using new geoinformation technologies. At the same time, modern scientists consider it necessary to participate in their development and improvement not only of narrow specialists in the field of IT and scientists but also of agricultural producers themselves. The development of new technologies is only possible with their widespread testing by business entities and using the information they accumulate, obtained using digital technologies, the design and application of which will be discussed in this study. Currently, the most widespread information technologies are "unmanned aerial systems" (UAVs), which combine various tools and approaches to collecting, processing, and analyzing data: information and communication technologies, sensors, robots, artificial intelligence, Internet of Things (IoT), Big Data, web applications and digital platforms. With the help of information technologies in agriculture, plant vegetation, the condition of agricultural land, as well as animal weight and physical condition are monitored. Technological processes in growing crops and keeping animals are monitored, which increases the efficiency of business entities and ensures the conservation of resources in the agricultural sector (Pajares 2015; Tang & Shao 2015; White *et al.* 2016; Goldman Sachs 2021). The technologies used make it possible to generate data of various types, which should be used to analyze the activities of business entities and make management decisions at different levels, along with information officially provided by statistical bodies, ministries and departments, scientific organizations, and private researchers. The issues of effective use of data in agriculture are given special attention by scientists from different countries (Gikunda *et al.* 2021; Borrero & Mariscal 2022), emphasizing the unequal access of different categories of farms to Big Data, which forms a separate value - a resource for making effective management decisions, due to the high cost of technologies for small forms of farming with low turnover, and also the lack of scientific publications presenting the results of their processing and analysis in the public domain (Shchepeleva *et al.* 2016; Wolfert *et al.* 2017; Weersink *et al.* 2018; Baseca *et al.* 2019; Su &Wang 2021; Migunov *et al.* 2021, 2023; Babanskaya *et al.* 2022; Javaid *et al.* 2022). For the production of organic products, one of the most important management decisions is the location of production across the territory, taking into account a set of conditions: soil-climatic, environmental, and socio-economic (Herrero *et al.* 2020; Zaruk *et al.* 2022; Sharma *et al.* 2022; Petrescu *et al.* 2022; Sgroi & Marino 2022; Abioye *et al.* 2022). The optimal territorial location of organic agriculture ensures a synergistic effect in related industries, which positively affects the development of the agricultural sector and the region's economy. This requires using data obtained from different sources. The basis is data from official statistics, surveys, and information from digital production technologies. Many researchers believe that the main task is to ensure the ability to compare data of different types based on specially developed information systems (Nenciu *et al.* 2023; Gageanu *et al.* 2023). As a rule, the information systems proposed by the authors are software products that combine the capabilities of digital technologies. In the work of Rank BS *et al.*, the digital platform concept is presented to ensure accessibility for target users and data security, compatibility and integration of data, data processing, and analysis (Runck *et al.* 2022). The authors reveal the features of digital technologies widely used in research and development in the food industry and agriculture, classifying them based on their functionality. All information tools are divided into web technologies and digital tools such as sensors, robotics, and Internet of Things technologies, and then into what constitutes a research platform and other related digital agricultural technologies (e.g., websites, repositories, archives, dashboards, and tools). The study categorizes web technologies according to their portability, extensibility, security, storage, interoperability, and processing capabilities, arguing that digital agriculture platforms include all six features. In contrast, subsets of these features characterize other technologies. The need to create information systems in agriculture aimed at collecting, processing data, and ensuring the possibility of their use by interested parties (farmers, marketers, researchers, etc.) is substantiated in several works by scientists from developed and developing agricultural countries of the world (Kysh 2021; Ajambo *et al.* 2022; Bwambale *et al.* 2022; Malone *et al.* 2022). At the same time, the following functions are highlighted:

E-commerce, which allows farmers and enterprises to trade directly;

Digital payments, savings, credit, and insurance services;

Content services, such as agricultural tips, information about weather conditions or market conditions.
The authors especially note the capabilities of information systems in providing farmers with access to financial resources (Gicheha & Misra 2020; Vajjhala Narasimha 2021; Jovic 2021; Global Digital Agriculture Platform Market Size Business Channel 2022). Of course, the information systems described in most scientific studies cover all agriculture sectors, but there are also specialized information systems designed to ensure the development of organic products. For example, Abayomi-Alli *et al.* proposed an ontology-based information extraction system for organic farming (Abayomi-Alli *et al.* 2021). The basis is to collect, store, and make organic farming information available to current and future software developers to develop an application for farmers, using Information Extraction (IE) and Ontology Engineering techniques to develop an Ontology Information Extraction (OBIE) system, called Ontology-Based Information Extraction System for Organic Agriculture (OBIESOF). That is, the system, in its functionality, is a knowledge base, as in many other works (Doanh *et al.* 2022; Zhukovskyy *et al.* 2022). Poppe *et al.* (2023) present an information system for environmentally responsible businesses that aims to meet the need for sustainability reporting in a way that reduces administrative burden. It is as user-friendly as possible, uses available data, and provides mechanisms to ensure the quality of sustainable development indicators. Benchmark Labs, one of the leaders in the application of artificial intelligence and machine learning in agriculture, 2022 presented the most relevant and functional information systems for agricultural management, which can become an incentive for the development of organic production, as they are aimed at reducing costs processing and reporting, managing accounts and tracking market prices, providing farm visibility through interactive crop maps, tracking weather conditions, managing soil moisture and carbon emissions. Livestock systems allow us to track livestock during grazing, manage breed composition based on analytics functions, optimize the feeding process, and make it as efficient as possible to increase animal productivity using only additives allowed in organic production and monitor the number of medications used for a specific animal (Benchmark Labs 2022). However, not a single work has noted that the accumulation of information, its analysis, and presentation of results using information systems can contribute to making management decisions regarding the rational use of resources with the optimal location of production of products, their types, including organic production, across the territory. The study presented by the authors aims to fill this gap. Consumer interest in organic products is based on the development in society of the idea of environmental protection, as well as a sufficient level of income for the population since production is mainly focused on the domestic market (Hansmann *et al.* 2020; Wiśniewski *et al.* 2021). To assess the location, various criteria are used, most often an indicator of elevation in the volume of production of organic products, an increase in sales volume to satisfy effective demand (KwadwoMpanga *et al.* 2021), as well as an expansion of acreage under organic farming. Scientists use various methods for the optimal location of agricultural products, which take into account the system of indicators of demography, the standard of living of the population, food prices, production indicators of crop and livestock production, bioclimatic potential of regions, etc., using economic and mathematical models (Evdokimova & Romanenko 2013; Putivskaya 2018; Altukhov *et al.* 2020; Kolesnikov & Vasilyeva 2021). However, a few methods exist for the optimal location of organic products by territory. This research aims to develop a concept for the optimal location of organic products based on an information system aimed at accumulating, processing, analyzing, visualizing, and providing data to users based on the combination of web and digital technologies that provide data. To achieve this goal, the following tasks were solved:

- A system of statistical indicators has been developed that characterizes climatic, environmental, and socio-economic factors in the production of organic products; a database has been created for the regions of the Russian Federation;
- A methodology has been proposed for clustering large territorial units (regions) for the possibility of producing organic products, taking into account a complex of natural and socio-economic conditions (characteristics);
- A system of statistical indicators and a methodology for identifying typical groups of small territorial units (municipalities) with different socio-economic conditions for the production and consumption of organic products have been developed;
- An information system module in the form of an interactive map was designed to visualize the results of designing the optimal location of organic production throughout the country;
- A methodology was developed for assessing carbon dioxide emissions as a characteristic of the degree of environmental responsibility of an enterprise, and a web application was created, which is an online calculator for calculating an enterprise's carbon footprint.

MATERIALS AND METHODS

The information basis for developing the Concept is official statistics data available to a wide range of users, published by the Federal State Statistics Service of Russia and its territorial bodies; Ministry of Agriculture, public organizations: Union of Organic Farming and Russian Organic Union.

When conducting the study, we took into account the principles of the development of organic production in Russia, noted in the regulations:

“Strategy for the development of production of organic products in the Russian Federation until 2030”, which presents a system of target indicators for the development of organic production in agriculture (volume of production of final organic products for the domestic market, dynamics of production of final organic products for the domestic market, volume of consumption of organic products, export organic products, area of land on which organic farming technology is applied);

Federal Law “On Organic Products and on Amendments to Certain Legislative Acts of the Russian Federation”, which regulates the content of the Concept of “organic products”, the basis of information and methodological support in the field of production of organic products.

The methodology for dividing territorial objects is based on induction and deduction methods, as well as a set of statistical analysis methods: factor analysis and cluster analysis. A large number of characteristics necessary for an objective assessment of the conditions for the production of organic products requires mathematical methods for their generalization to reduce predictors when dividing population elements into typical groups. Factor analysis is a method of mathematical statistics aimed at the formation of conditional variables (principal components) when generalizing the initial characteristics based on their linear combinations $\{\eta\}p_i = 1$(indicators in each group) with a vector of means m = (m_1,..., m_p) and the covariance matrix D = (σij), from which a compressed description of the structure of the dependence can be obtained:

$$\eta_1 = \sum_{j=1}^{p} \alpha_{1j}\xi_j \ \dots \ \eta_p = \sum_{j=1}^{p} \alpha_{pj}\xi_j \qquad \textbf{(1)}$$

The cluster analysis method is one of the most commonly used statistical methods for grouping elements of a population according to a set of characteristics, as a result of which elements included in one group were as “similar” as possible, and elements from different groups were as “different” from each other as possible. This method allowed the authors to identify groups of homogeneous large and small territorial units regarding the conditions for producing organic products of groups of regions (clusters). The authors propose to use a clustering model based on k-means since the methodology involves the differentiation of a large number of population units, and the Euclidean distance, calculated by the formula, is used as a metric:

$$d_{Eij} = \sqrt{\sum_{i=1}^{m}\left(x_i^l - x_j^l\right)^2} \qquad \textbf{(2)}$$

where x_i^l : the value of characteristic l by population element (region) i

x_j^l: the value of characteristic l by population element (region) j

At the same time, it is proposed that the optimal number of clusters be determined using the “NbClust” package in the R programming environment as the most accessible means of data analysis.

A similar approach to identifying homogeneous groups of objects is often used when conducting agroeconomic research, for example, in the works (Platania 2014; Szafrańska 2018; HlouškováandLekešová 2020). Python was used as a tool for the analysis and development of an interactive map. This programming language is actively used for various tasks, including developing maps. This language is used in scientific developments by domestic scientists (Polyakova 2019; Kalugin 2023) and international practice (Uludağ 2023). The Pandas and Scikit-learn libraries were used to conduct the analysis, allowing us to process and load source data and build high-quality machine-learning models. The Geographic data of Russia's constituent entities and their administrative boundaries were presented in the GeoJSON format – an open format designed for storing geographic data structures based on JSON. The format can store primitive types for describing geographic objects, such as points, lines, and polygons. The panda's extension (GeoPandas), was used to work with this format, and the Folium library was used to develop the map. It has sufficient functionality for visualization, while it has the simplest and most understandable software interface among the alternatives: Plotly and Altait. Folium library makes visualizing data processed in Python on an interactive map easy. This allows us to bind data to the map to visualize background cartograms and transfer advanced vector, raster, and HTML visualizations as markers on the map. When developing an Online Calculator of the carbon footprint generated as a result of the activities of an agricultural enterprise, the following groups of indicators were used, taking into account emission factors:

1. Livestock numbers and types of animals. Since livestock production is one of the main sources of greenhouse gas emissions in agriculture, it is necessary to consider the numbers and types of livestock raised: cattle, pigs, sheep, goats, and poultry, which have different environmental impacts. When calculating greenhouse gas emissions, it is necessary to use methane emission factors for different animal species. Based on these coefficients and data on the number of livestock, diet composition, and other parameters, the carbon footprint of the enterprise can be calculated;
2. Quantity and type of fertilizer applied. For example, the use of fertilizers, in particular nitrogen fertilizers, is associated with significant emissions of nitrogen oxide, the amount of which is determined taking into account the greenhouse gas emission coefficients when using fertilizers in Russia;
3. Area and yield productivity of crops. The higher the yield, the more biomass is formed in each unit of the sown area, which means more greenhouse gas emissions. Some crops, such as rice or intensive corn fields, may produce large amounts of emissions, while other crops, such as wheat or barley, may have smaller emissions. Thus, when calculating the carbon footprint from growing crops in Russia, the following coefficients are used to calculate CO_2 emissions when decomposing the organic matter of the earth:

Cereals - 5-14 kg CO_2 ha^{-1}
Oilseeds - 11-23 kg CO_2 ha^{-1}
Industrial crops - 7-15 kg CO_2 ha^{-1}

4. Type, power, time of use of equipment, type of work performed, type and fuel consumption. Thus, average CO_2 emissions from the use of technology:

Tractor - 0.55 kg CO_2 min^{-1} of activity
Harvester - 0.6 kg CO_2 min^{-1} of activity
Seeder - 0.4 kg CO min^{-1} of activity etc.

To develop an online calculator, various tools and approaches were used to create a server and user interface. The Rust programming language was used to develop the server, as it provides the highest level of security and economical use of computer memory. To create web applications in Rust, the Actix-Web framework is used, which is highly productive and easy to write code, so experts prefer it. Among the advantages are type safety (minimizing type inconsistencies), comprehensive functionality, and the ability to create your libraries if necessary. The Calculator involves calculating the carbon footprint multiple times and storing the results for further analysis, i.e., a website needs to have a system that will ensure the safe and correct receipt of data, its storage, and management. For this purpose, there are databases (DBs) and their management systems (DBMSs). In our case, we will use the MongoDB DBMS, which was created for document-oriented data models. Eliminating the use of circuits also improves overall system performance. The DBMS stands out from other tools due to its properties as cross-platform, data format, using collections instead of tables, data replication, information indexing, its technology for storing large data, query search, a balancer, and cloud storage capabilities. When developing the client part, the programming languages CSS and JavaScript were used, which are fundamental for front-end development. Thanks to them, the site structure and element styles are set. To manage the data state and user interface, the system uses the functionality of the Redux tool, which is essentially a JavaScript library. For ease of use, an editor called WebStorm, specifically designed for programming in JavaScript, was selected. It contains all the necessary tools for web development, popular plugins and frameworks, a powerful analyzer, a convenient engine for testing code, a modern debugger, cross-platform.

RESULTS AND DISCUSSION

The authors propose that the optimal location of production across a territory is the implementation of economic activities on the territory subject to the following criteria: rational use of natural and economic resources, maximizing production volumes, and/or profits from product sales. The Concept of optimal location proposed by the authors is presented in Table 1. The basis for the optimal location of the production of organic products across the territory is a set of conditions common to all industries and technologies of agriculture and specific ones. General conditions are represented by soil and climatic characteristics that provide a sufficient level of solar radiation, soil, and air humidity throughout the growing season of plants, nutrients, and microelements in the soil;

economic characteristics of the region regarding labor resources, infrastructure, etc. Organic agriculture as the basis of a resource-saving, sustainable economy requires using digital technologies of precision farming and "smart farms". Therefore, it is more expensive and requires a high level of development of the territory, including technological development and the presence of effective demand for expensive products. Also, when locating organic production, it is necessary to consider several environmental characteristics of the territory. Thus, the system of indicators for objective assessment of the territory from the point of view of the possibility of locating organic production includes the following groups of relative and mean values: level of development of the region, level of development of agriculture, standards of living; climatic conditions; environmental conditions.

Table 1. The concept of optimal placement of organic production facilities across the territory using IP.

Definition	**Carrying out economic activities on the territory subject to the following criteria: rational use of natural and economic resources; maximizing production volumes and/or profits from product sales**
Optimal location factors	Socio-economic conditions: • level of development of the region; • level of development of agriculture; • standards of living; Climatic conditions; Environmental conditions.
Methodology	1. Development of a system of statistical indicators of the conditions for the production and sale of organic crop products, taking into account available information within the framework of official statistical observation and departmental reporting; 2. Formation of a database for large (regions) and small (municipalities) territorial units; 3. Calculation of system indicators for each element of the population being studied – the object of study; 4. Formation of components of the conditions for the production of organic products based on groups of the system of indicators for large territorial units using the method of factor analysis; 5. Distribution of the studied population of large territorial units (regions) into groups with different conditions (climatic, socio-economic, environmental) and potential for the development of organic production based on the application of the cluster analysis method; 6. Description of the selected groups of elements in terms of conditions and possible directions for the production of organic products; 7. Identification of groups of small territorial units (municipalities) that are homogeneous in terms of socio-economic and environmental conditions of production; 8. Clarification of possible directions of production activities within the framework of organic technologies for each group of small territorial units (municipalities); 9. Visualization of the obtained results of territory typification in the form of an interactive map; 10. Determining the category of an economic entity from the point of view of environmental responsibility as a potential producer of organic products.
Implementation of the methodology based on IS	Module "Database"; Module "Clustering of large territorial units"; Module "Clustering of small territorial units"; Module "Visualization of clustering - interactive map"; Module "Carbon Footprint Calculator".
Directions for using IS modules by user categories	Producers and processors of agricultural products; Management bodies in agriculture; International organizations; Organic consumers; Mass media; Consulting and insurance companies.

*developed by the authors.

Calculating indicators for the production conditions of organic products requires using data obtained from various sources and processing from the point of view of ensuring comparability and reliability. In order to collect, process, and store information on elements of the statistical population and its aggregation, a "Database" module has been developed in the information system, aggregating information published by international organizations, the Federal State Statistics Service, departments, and public and research organizations. The information support scheme for the optimal placement of organic products is presented in Fig. 1. The "Database" information system module collects, processes, and calculates statistical indicators of the conditions for the production of organic products. Fig. 2 presents the general diagram of the information system. The clustering of large territorial units is carried out in the appropriate module based on relative and average indicators calculated in the database, characterizing socio-economic, environmental, and climatic conditions. The testing carried out in the regions of the Russian Federation made it possible to identify seven groups that are homogeneous in terms of the conditions

for the production of organic products, which provides an opportunity for producers and governing bodies of each region to determine the most effective direction of activity and investment. Territorial units are divided into 7 clusters:
Regions: consumers of organic products, potential producers if the environment improves;
Regions: potential producers of environmentally friendly feed for livestock industries with an increase in the level of digitalization of agriculture;
Regions: consumers of organic products;
Regions: producers of organic products for domestic consumption;
Regions: with the highest potential for producing organic products for export;
Consumer regions of organic products that can be produced in the risky farming zone;
Regions: potential producers of environmentally friendly feed with improved environmental conditions (Fig. 3).

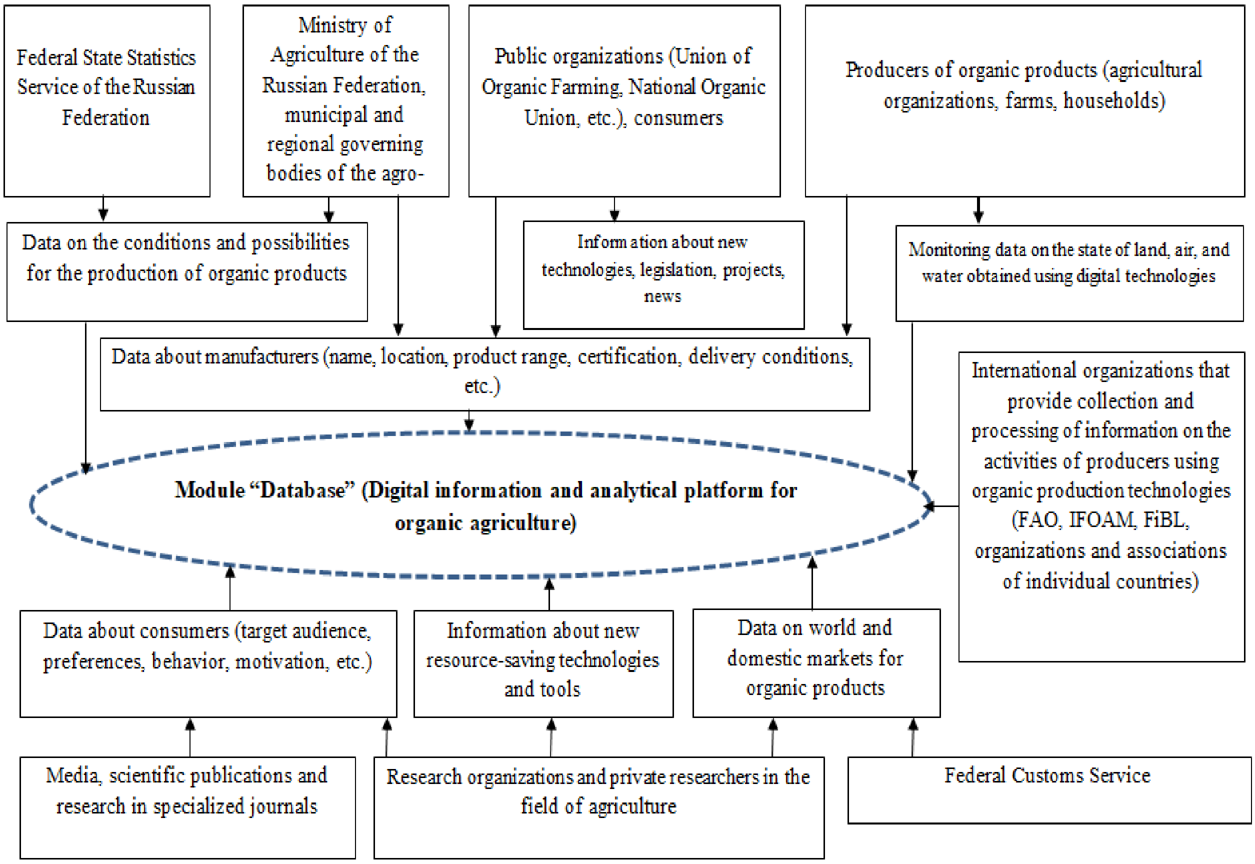

Fig. 1. Scheme of information support for the implementation of the concept of optimal placement of organic products*; *developed by the authors.

The territorial organization of large regions is a system of municipalities: small territorial entities that have various socio-economic characteristics, including the level of development of traditional agriculture, income of the population, infrastructure of rural areas, as well as environmental conditions that form stimulating and limiting conditions for the development of organic agriculture. The work of this module was tested in the municipalities of two regions with developed traditional agriculture and high potential for the development of organic production: the Stavropol Region and the Penza Region. For each region, three clusters of municipalities have been identified: potential producers subject to improved environmental performance, potential producers subject to an increase in digitalization, and consumers of organic products. An example is shown in Fig. 4. The visualization module is an interactive map of the Russian Federation. The user can see two sections of the module - clusters of regions of the Russian Federation and clusters of municipalities. Also, on the map field, you can select a group of characteristics of conditions for producing organic agricultural products. The functionality of the map allows us to move the cursor over a specific region (for the first section) or municipality (for the second section) to see the region's name, the cluster to which it belongs, and the numerical values of the indicators. This allows the user to determine the possibility of locating the production of organic products on the territory, as well as independently highlighting the limiting conditions for solving this problem and requiring adjustment.

Fig. 2. Diagram of an information system for implementing the concept of optimal placement of production of organic agricultural products*; *developed by the authors.

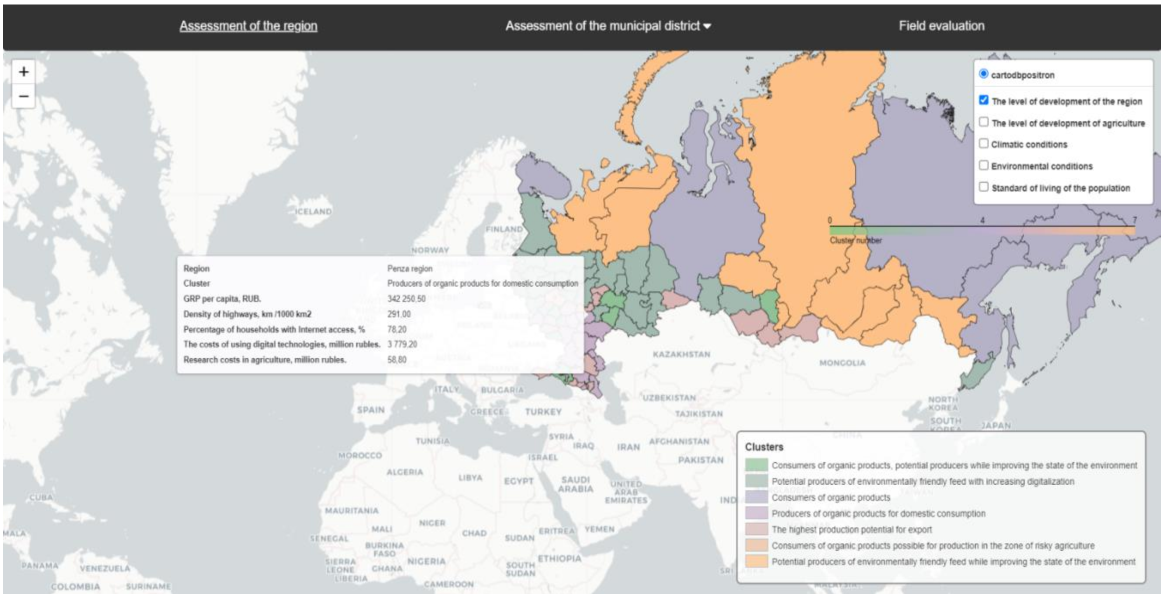

Fig. 3. Interactive map of regions of the Russian Federation indicating clusters and conditions for the production of organic products*; *developed by the authors based on the results of the analysis.

The "Online Calculator" module is aimed at calculating the carbon footprint indicator based on data on the conditions and results of economic activities of a specific manufacturer, which allows you to determine the level of environmental safety of production and the possibility of the manufacturer's participation under existing conditions in the placement of organic production, as well as determine which elements are responsible for exceeding the carbon footprint standard and develop a methodology for its adjustment.

Users of the data obtained through the use of the proposed information system, as the basis for implementing the Concept of optimal location of organic products, can be represented by the following groups:

ü Agricultural producers and processing organizations;

ü Agricultural authorities at different levels;

ü International organizations collecting and processing information on organic production, participating in the management of organic agriculture;
ü Consumers of organic products;
ü Consulting services, financial corporations, including credit and insurance organizations.

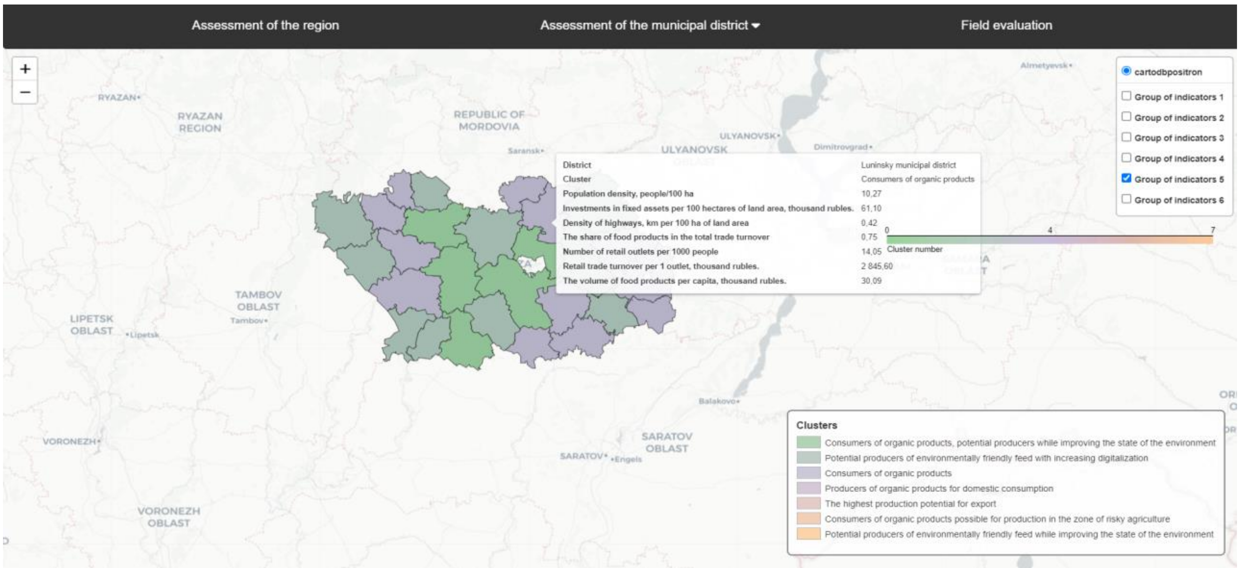

Fig. 4. Interactive map of the Penza region indicating clusters of municipalities according to the conditions of production of organic products; * developed by the authors based on the results of the analysis.

Each user group has its directions for applying the information obtained during the implementation of the proposed information system. Producers of agricultural products receive information based on which it is possible to evaluate the territory on which production is already carried out using traditional technologies or the territory on which land is located that has not previously been used for agricultural production from the point of view of the possibility of placing organic production on it with taking into account a set of conditions, including environmental characteristics and indicators of potential effective demand for this type of product that are important for any manufacturer. Agricultural management bodies have the opportunity to obtain a more complete description of the territory based on the database. They can then determine areas of support for farmers and develop organic production as the basis for achieving sustainable development goals. Using an interactive map allows them to reduce the time for analysis and management decisions. The implementation of the Concept of optimal placement of organic products will ensure the achievement of target indicators of the “Strategy for the development of organic production in the Russian Federation until 2030”, increase the productivity of crops and livestock, elevating the volume of livestock and crop production with the rational use of resources. International organizations in the current conditions are faced with insufficient data on organic agriculture by country, making it difficult to analyze and develop a unified strategy for achieving sustainable development goals by implementing innovative, resource-saving technologies in the agricultural sector. Using the database proposed by the authors and information obtained from the results of clustering of territorial units will make it possible to fill some of the existing gaps not only for the Russian Federation but also for other countries since this system has a high scaling potential for countries with a large territorial extent and a high degree of social variation: economic, climatic and environmental conditions. Consumers of organic products will be able to accurately determine the possibility of producing organic products in a particular region using an interactive map. This will reduce the likelihood of purchasing a counterfeit product, increase the reputation of “honest” producers, and encourage the development of organic agriculture. The creation of an information system for the implementation of the Concept of optimal placement of production of organic agricultural products will help improve the pricing policy in the agricultural insurance market and create specific insurance products that take into account the characteristics of organic producers based on the experience of leading countries with a developed organic market. Access to the system of indicators will calculate insurance rates more accurately and include the features of production conditions at the meso- and micro levels. For consulting, assessment, and audit companies, using an information system will facilitate a detailed analysis of the financial and economic activities of organic producer organizations, strategic planning, and forecasting, identifying risks that contribute to organic production and sales of products, making management decisions, constructing financial models and development strategies. Often, the lack of demand for innovative products and trust in manufacturers is associated with unreliable data published by the media, and many fakes appear due to the media's ignorance of the basics of the phenomenon or process being covered. Access to the database proposed by the authors, the ability to use an interactive map will increase the level of awareness of media representatives, provide a reliable basis for preparing materials, honest coverage of the problems and advantages of an important direction in the development of modern agriculture. General directions in the development of the agricultural sector of the countries of the world, determined by the need for resource conservation, conservation of biodiversity, and ensuring food security while simultaneously solving the problem of healthy nutrition of the population, are associated with the production of organic products, as noted by many authors (Herrero *et al.* 2020; Sharma *et al.* 2022; Petrescu *et al.* 2022). At the same time, most works confirm the hypothesis of this study about the need to use digital technologies not only in the implementation of technological processes in crop production and livestock farming but also in the accumulation, processing, storage, and dissemination of data as the basis for effective management (Baseca *et al.* 2019; Su & Wang 2021; Javaid *et al.* 2022). One of the relevant management issues in the agricultural sector for countries with high climatic, economic, and environmental variations (countries with a large territorial extent) is the optimization of production location. To a greater extent, this applies specifically to organic agriculture because there is no way to level out (reduce) the degree of influence of the listed factors through using mineral fertilizers, plant protection products, etc. (Sgroi & Marino 2022; Abioye *et al.* 2022). This confirms the possibility of using the developed Concept of optimal location in the territories of other countries. The methodology underlying the Concept was tested using official statistical data that is freely available. Therefore, the typification of territories was limited to regions and municipalities. Further development of the Concept in terms of the methodology for determining the territory from the point of view of the possibility of producing organic products may be in the direction of clarifying the characteristics of a separate field within the enterprise (Malone *et al.* 2022). Producers with different activity scales can use this, both small farmers and large agricultural holdings, not only for production within one farm, but also when identifying opportunities for cooperation with neighboring organizations to reduce costs and increase the efficiency of production and sale of organic products. However, to continue working with smaller territorial units, it is necessary to conduct separate specially organized surveillance, including using UAVs, which is currently causing difficulties in several countries (Bwambale *et al.* 2022; Malone *et al.* 2022). The modules presented in the Concept, in particular the "Database" module, involve using big data streams, i.e., are based on using digital technologies, which can also become a limitation for the full use of the Concept in developing countries with limited financial resources among agricultural producers and the presence of territories without access to the Internet.

CONCLUSION

The developed Concept of optimal location of organic agricultural production is based on long-term research conducted by the authors, which made it possible to determine a system of indicators that comprehensively characterize the conditions for producing organic products. Considering the territory's climatic, environmental, and socio-economic characteristics when assessing the possibility of growing organic products makes it possible to effectively use available resources, minimize production costs, and ensure a physiologically determined level of productivity of crops and animals. Implementing the approach to typing territories for the production of organic products inherent in the Concept requires the creation of a database based on information generated and published by various sources, using complex statistical methods in terms of calculations. This necessitates using information technology. This problem was solved in the work. The information system, which includes five modules, makes it possible to fully implement the Concept developed by the authors, as well as provide up-to-date, reliable information for several users, which will contribute to the popularization of organic products and create the basis for the development of resource-saving technologies and agricultural sustainability.

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