

# Directions for food security auditing

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**Abstract.** Background. This study examines the process of food security auditing as a comprehensive assessment of the system ensuring food supply to the population. Objective. The research aims to outline key directions for food security auditing and develop indicators for quantifying the level of food security. Materials and methods. The research predetermines the study of the regulatory framework, as well as a review of the opinions of various authors on the problems of food security in Russia. The methodological basis of the study were the methods of analysis, induction, deduction, abstraction in the context of the selected topic. Results. The study explores critical aspects such as risk identification, food quality and accessibility assessment, and resource management, considering environmental, economic, and social factors. Special attention is given to the stages of preparation, data collection, analysis, and the development of recommendations to enhance the resilience of the food system. The research underscores the importance of integrating international standards and employing advanced analytical methodologies, such as HACCP, to achieve high levels of food safety and quality. The article also presents key quantitative indicators for food security assessment and offers practical recommendations for mitigating risks associated with food shortages or quality deterioration. Conclusion. The study concludes that a systematic approach to food security auditing necessitates the integration of environmental, economic, and social considerations.

## 1 Introduction

Food safety audit is a comprehensive assessment of the food supply system aimed at identifying vulnerabilities and potential risks associated with food production, distribution, and consumption. This process involves a detailed analysis of food resource availability and sustainability, as well as an evaluation of the effectiveness of existing management mechanisms and quality control systems. The audit methodology relies on standardized indicators, statistical data, and comparative analysis with international benchmarks, ensuring an objective evaluation of the food system's status. Key factors such as climate change, economic stability, social conditions, and political decisions influencing food security are also taken into account. The findings of such audits contribute to the development of policy recommendations aimed at optimizing food security strategies,

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enhancing self-sufficiency, and improving resilience to external shocks. Ultimately, these efforts ensure long-term food security and societal stability.

The concept of food safety audit emerged in the mid-20th century in response to the growing need for a reliable and safe food supply amid global changes and increasing urbanization. In the 1960s, Pillsbury, in collaboration with NASA and the U.S. Army Laboratories, developed the Hazard Analysis and Critical Control Points (HACCP) system to ensure food safety in space missions. This approach later became the foundation for modern food safety auditing methods, which focus on risk prevention at every stage of the food supply chain [1-7].

**Objective.** The aim of the study is to define key directions in food security auditing and establish measurable indicators for quantifying food security levels. The research is theoretical in nature and focuses on developing procurement strategies from an environmental sustainability perspective.

## 2 Materials and methods

The study is based on an analysis of legal and regulatory frameworks as well as a review of various scholarly perspectives on food security in Russia. The research includes an analytical overview of food safety challenges in general [1, 2, 5, 7-10], with particular attention to the regional dimension [6], the international approach to food safety [4], and food safety standardization [3]. The methodological framework incorporates both qualitative and quantitative research methods, including analysis, induction, deduction, and abstraction techniques.

## 3 Results of the research

In Russia, food security auditing primarily aims to ensure national food independence, as defined in the Food Security Doctrine, which sets threshold values for the proportion of key food products produced domestically. Unlike Western countries, where the focus is on integrating into global food supply chains and diversifying sources of imports, the Russian approach emphasizes reducing import dependency and strengthening the domestic agricultural sector. Eastern countries, such as China and Japan, also seek food self-sufficiency but use different strategies, including significant investments in foreign agricultural projects and importing food to meet domestic demand. As a result, Russia's food security audit is characterized by its strong focus on domestic production and self-sufficiency, with the goal of enhancing national security and minimizing the impact of external market forces [4].

Food audit covers a wide range of areas, each with its own objectives, methods, and applications. One of the most important types is food safety auditing, which assesses compliance with regulatory standards in food production, storage, and transportation. This audit includes evaluating quality management systems, such as the implementation of Hazard Analysis and Critical Control Points (HACCP) principles, and ensuring compliance with sanitary and hygiene regulations (Table 1).

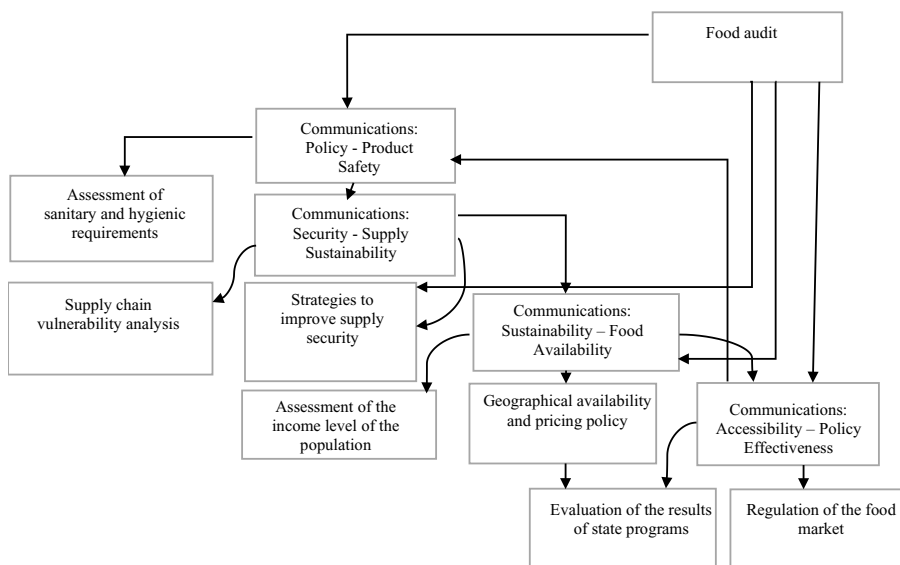
**Table 1.** HACCP principles.

HACCP principles	Description
Identification of potential risks	Identification of all possible biological, chemical and physical hazards that may arise at various stages of production and distribution.
Definition of critical control points (CCP)	Identifying points in the process where identified risks can be effectively managed or prevented.
Setting critical limits	Determination of limit values for each risk in CCP, the violation of which may lead to unsafe product.
Development of a monitoring system	Establish procedures for monitoring and verifying compliance with critical limits at each CCP.
Developing corrective actions	Identification of actions necessary to eliminate deviations from critical limits and prevent recurrence of violations.
System check	Establishing procedures to verify the effectiveness of the overall HACCP system, including process testing and compliance auditing.
Documentation and record keeping	Develop and maintain documentation including HACCP plans, monitoring reports, corrective actions and audit results.

Another type is food sustainability audit, which studies the supply system's capabilities for long-term satisfaction of the population's needs for food products, taking into account climatic, economic and social factors. This area of audit allows identifying vulnerabilities in the supply chain and developing strategies to improve its reliability.

Food availability audit evaluates social and economic aspects, including the income level of the population, geographic accessibility and pricing policy, which is especially important for assessing food security in poor and remote regions. There is also an audit of the effectiveness of food policy, which focuses on assessing the results of government programs and initiatives aimed at supporting agricultural production and regulating the food market.

All of the listed areas of food audit are interconnected and complement each other, which allows for a comprehensive picture of the state of the food system and the development of effective measures to optimize it (Figure 1).



**Fig. 1.** Interrelation and directions of audit in the food safety system. Source: compiled by the authors based on [5].

Each area is detailed through relevant tasks, such as quality systems analysis, supply chain assessment, geographic availability and public policy. The diagram shows the relationships between audit areas, which reflect their complex interaction. For example, product safety is directly related to the sustainability of the supply system, and food availability is related to the effectiveness of public policy. The diagram emphasizes that only the integration of these approaches allows us to form a complete understanding of the state of the food system and develop strategies for its optimization.

Food security audits are conducted in several successive stages, each of which has its own goals, objectives and requires certain resources. The first stage includes preparation and planning of the audit. The purpose of this stage is to determine its scope, objectives and methods. At this stage, a team of auditors is formed, which should include specialists in agriculture, logistics, law and quality management. An audit program is also developed, including a list of objects to be checked, data collection methods and analysis tools.

At the second stage, data is collected for analysis. The purpose of the second stage is to collect and obtain objective information on the current state of food security. Information is collected on production processes, food transportation methods, and the availability of food products for the entire population of the country.

The third stage is the analysis of the data obtained during the second stage, which will allow identifying possible risks based on the information. At this stage, a thorough study of food security as a whole is carried out, for example, an assessment of the quality of production, a study of the physical and economic availability of food, logistics chains, etc. The main goal is to find and identify possible violations in these processes.

The next stage involves the development of a set of measures to reduce the identified risks, as well as maintaining the sustainability of food security in the country. The set of measures may include the introduction of new technologies in production, improvement of the logistics system, as well as possible adjustments to legislation.

The final stage is based on monitoring the effectiveness of the recommended set of measures to eliminate the identified risks. Its purpose is to control the implementation and quality of the implemented measures to improve food security.

All stages of the food security audit involve the expenditure of human and financial resources, which also affect the time frame. There is no strictly regulated time for performing an audit, since it depends on many factors, such as the complexity and scale of the study, the quality and timely implementation of recommended measures to effectively eliminate risks, and others.

Indicators for quantitative determination of the level of food security are an important tool for analyzing the state of the food system and allow an objective assessment of its sustainability. Each of the indicators is determined on the basis of specific criteria that take into account the availability, quality and sustainability of food resources [6]. Table 2 presents the main indicators and the corresponding criteria for their selection.

**Table 2.** Indicators for quantitative determination of the level of food security and the criteria for their selection.

Indicator	Description	Selection criteria	Calculation formula
Share of national food production	The percentage of domestically produced goods in total consumption.	Level of self-sufficiency and reduction of dependence on imports.	$(\text{Country production volume} / \text{Total consumption volume}) * 100$
Food Availability Index	Assessment of food availability for different population groups, including financial availability.	Social justice and the level of income of the population.	$(\text{Average income} / \text{Average cost of food basket}) * 100$
Food loss rate	The proportion of food lost during production, transportation and storage.	Efficiency of logistics systems and prevention of resource losses.	$(\text{Amount of food lost} / \text{Total amount of food produced}) *$

			100
Volume of strategic reserves	The amount of food in national reserve funds.	Resilience to emergencies and ensuring national security.	Total stock by product category (in tons or other units of measurement)
Average Daily Caloric Intake	Average number of calories available per capita.	Compliance with physiological nutritional norms.	Total Available Calories / Population
Level of food imports	Percentage of imports in total food consumption.	Vulnerability of the national economy to external factors.	(Import volume / Total consumption volume) * 100
Number of agricultural lands	Area of land used for food production.	Potential for sustainable agricultural production.	Total agricultural land (in hectares)
Food Quality and Safety Index	A comprehensive indicator that takes into account the content of harmful substances and the compliance of products with standards.	Population health level and compliance with international food safety requirements.	Rating (Sum of product quality check results / Total number of checks) * 100

The presented indicators allow for a comprehensive assessment of the level of food security, taking into account key aspects — from self-sufficiency and accessibility to quality and sustainability of the system. Their selection is based on criteria that reflect both national and international priorities in the field of food security.

Independent verification of the reliability of data reflecting the availability and quality of food is a key element of food security management. For this purpose, standardized procedures for collecting and analyzing information are used, including laboratory tests of product quality, monitoring of supply chains and audits of production processes. The involvement of accredited organizations and independent experts ensures objectivity, and the use of international standards such as HACCP or ISO guarantees data comparability. These results form the basis for assessing the current state of the food system and identifying potential problems [3].

Based on verified data, an assessment of the effectiveness of measures aimed at increasing food sustainability is carried out. The comprehensive analysis includes time series, comparative analysis of indicators before and after the implementation of specific measures, as well as taking into account feedback from key participants in the food system. For example, a reduction in the level of losses in the supply chain or an increase in the share of local production indicate a positive impact of the measures taken. These results are used to adjust the strategy, which allows for timely adaptation to changing conditions [5].

The definition of priority areas of public policy in this area is based on the data of the analysis of effectiveness and verification. Using predictive models and expert assessments, key challenges are identified, such as the impact of climate change, population growth or changes in global economic conditions. These factors determine the need to develop agricultural infrastructure, introduce innovative technologies and increase strategic food reserves. Priorities are also aimed at achieving maximum self-sufficiency and reducing dependence on imports.

The formation of food security strategies requires taking into account both regional and international factors. Regional characteristics, including resource availability, level of economic activity and state of infrastructure, determine local approaches to food provision. At the same time, international commitments, such as participation in World Trade Organization agreements or integration with global supply chains, form an additional framework for public policy. The balance between these levels allows for national interests to be taken into account, ensuring the sustainability of the food system in the face of

external and internal challenges. Assessing the reliability of the infrastructure for storing and distributing food resources is a key stage in analyzing the state of the food system. The process is based on the use of systems analysis methods, including logical-probabilistic approaches, graphical models and differential assessment methods. The use of such tools allows us to identify weaknesses in the functioning of the infrastructure, predict the probability of failures and assess their intensity. The data obtained serve as a basis for developing recommendations aimed at increasing the sustainability and efficiency of logistics systems that ensure the stability of food supply [3]. Based on the analysis of the infrastructure, it becomes necessary to take into account a wider range of factors, such as environmental, economic and social parameters, which makes the integration of these aspects a key element of the food safety audit system. The integration of environmental, economic and social parameters is carried out through a comprehensive environmental audit. The main objective of this process is to assess the compliance of economic entities with legislative requirements in the field of environmental protection and minimization of environmental risks arising at various stages of the production and distribution chain. Social aspects include an analysis of the availability of food for various categories of the population, taking into account their economic capabilities and needs. This approach provides a holistic view of the impact of the food system on the environment and social sustainability.

Comprehensive consideration of environmental and social factors requires clear regulation and implementation of uniform standards, which emphasizes the importance of establishing standards governing food safety and quality. The establishment of such standards is based on international requirements, including ISO 22000, as well as national legislation. The formation of standards involves expert assessments, analysis of existing regulatory acts and testing of new methods in practice. Their implementation contributes to the unification of approaches to ensuring the quality and safety of food products, and also facilitates the integration of national producers into global food chains [2]. Effective use of standards and regulations allows not only to ensure compliance with product quality, but also to study in more detail the dynamics of changes in the provision of food to various social groups. The analysis of this dynamics is carried out through the use of statistical methods and systematic monitoring of key indicators of food security. The use of econometric models and time series data allows identifying the most vulnerable groups of the population subject to shortages or declining food quality. The results obtained serve as a basis for developing targeted strategies aimed at increasing the availability of food for these categories of citizens.

Identifying vulnerable groups and studying the dynamics of food supply requires assessing the effectiveness of measures aimed at reducing the risks of shortages or deterioration in food quality. Such an assessment is based on risk-oriented approaches, including scenario modeling and analysis of the probability of critical situations. The use of these methods allows developing preventive measures and increasing the resilience of the food system. The systemic nature of the assessment helps to adapt management strategies to changing conditions and ensures their long-term effectiveness [4]. Based on the data from the available data, as an example of studying the selected research topic, it is possible to trace the dynamics of the food security audit in Russia for the period 2019–2021, analyzing the key indicators presented in Figure 2.

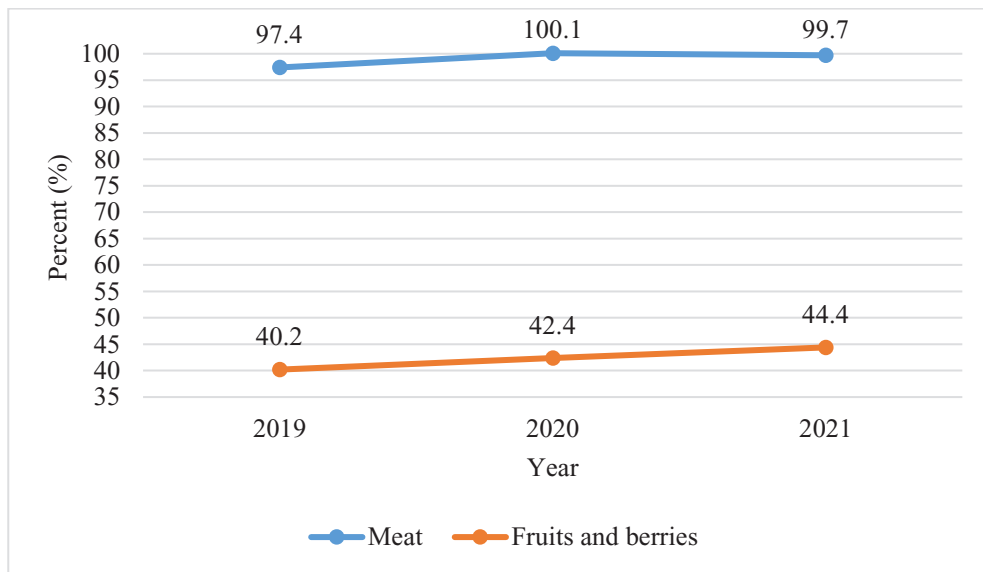


Fig. 2. Self-sufficiency level in 2019-2021 [8].

According to the data in Figure 2, the level of self-sufficiency in the main food categories in Russia remained high, with the exception of certain items. For example, in 2021, the level of self-sufficiency in meat exceeded the standard by 14.7 percentage points, while for fruits and berries it was below the standard by 15.6 percentage points. The main reason for the lag is the insufficient growth rate of domestic fruit production and their replacement with imported products. On the other hand, agricultural production increased overall: over the period 2014–2021, the volume of crop production increased by 79.5%, and livestock production by 40.7%. The economic availability of food is presented in Figure 3.

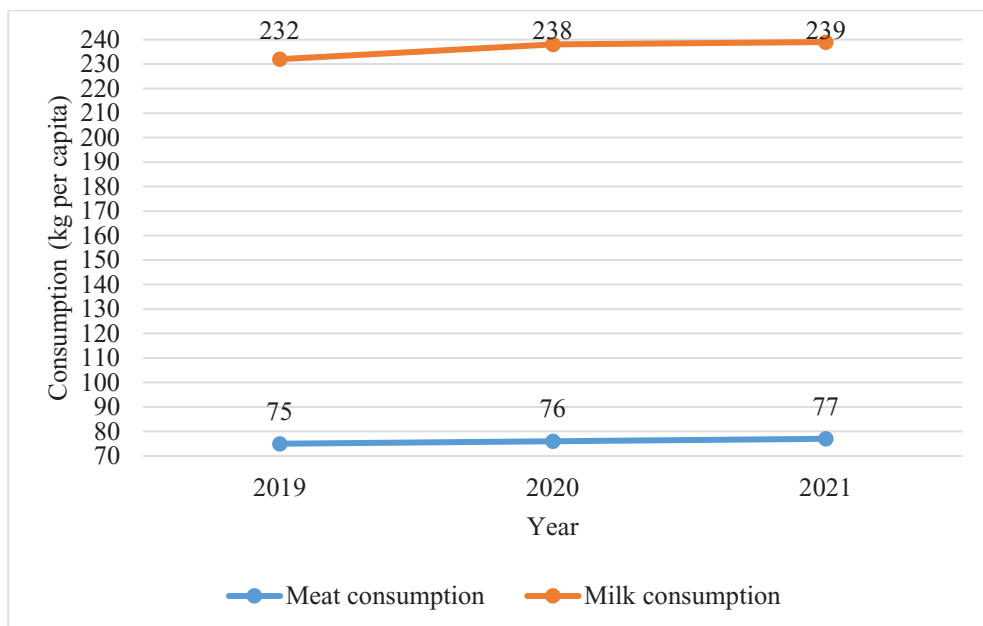
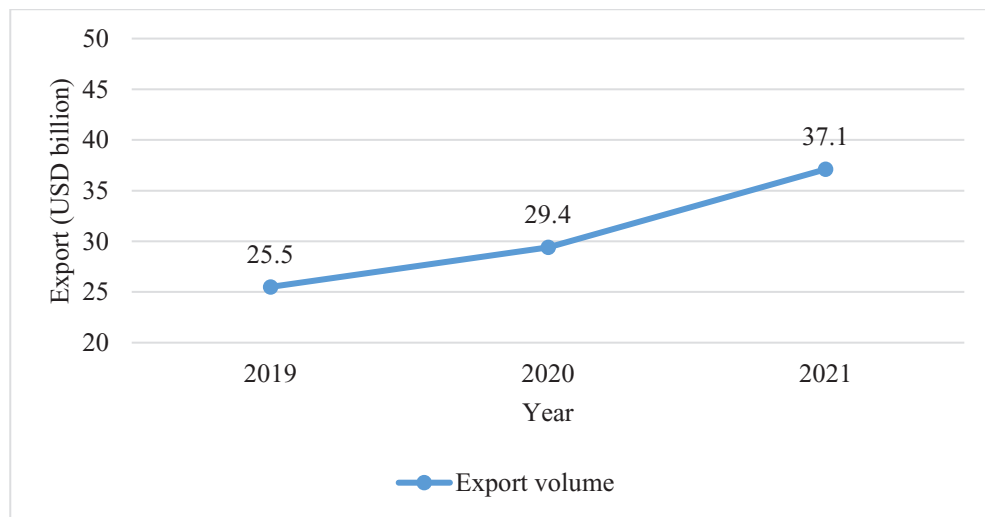


Fig. 3. Economic affordability of products in 2019-2021 [8].

Economic availability of food demonstrated positive dynamics. In particular, the actual level of consumption of meat, eggs, sugar, vegetable oil and bread products exceeded the rational standards recommended by the Russian Ministry of Health. Thus, in 2021, meat consumption amounted to 77 kg per capita against 75 kg in 2019. Similarly, milk consumption increased from 232 kg in 2019 to 239 kg in 2021.

Agricultural exports in 2019-2021 are presented in Figure 4.



**Fig. 4.** Agricultural exports in 2019-2021 [8].

Food exports also showed growth. In 2021, agricultural exports reached \$37.1 billion, up 21.4% year-on-year in value terms and 10.4% in volume. Russia remained the world's largest wheat exporter, with exports amounting to 37.3 million tons in 2020. It should be noted that over the past decades, wheat exports from Russia have increased by approximately 9% annually [9]. However, despite the increase in production and exports, there remained a dependence on imported components, such as sugar beet seeds (imports account for 97%) and genetic material for poultry farming [10]. These indicators indicate that Russia has made significant progress in ensuring food security, despite external economic restrictions and sanctions. However, the continuing risks of import dependence and logistical constraints require further work to improve the sustainability of the food system and diversify foreign trade.

## 4 Conclusion

Food security audit is a key tool for ensuring the sustainability of the food supply system and reducing the risks associated with shortages, deterioration in product quality or external shocks. This process involves a comprehensive approach based on multi-level analysis, standardization of procedures and continuous adaptation to changing conditions. The main stages of the audit include infrastructure assessment, monitoring of production processes, analysis of supply chains and forecasting possible threats.

The systemic nature of food security audit necessitates the integration of environmental, economic and social factors. Taking into account environmental aspects helps to minimize the negative impact on the environment and adapt to climate change. Social parameters help ensure access to food for all groups of the population, which is especially important in



the context of growing global inequality. The economic component of the audit is aimed at increasing production efficiency, reducing food losses and minimizing dependence on external sources.

Thus, food security audit plays a strategic role in ensuring the sustainable development of the food system, protecting the interests of both producers and consumers. Its importance is increasing in the context of global changes, requiring an integrated approach and coordination of efforts at all levels of governance.

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