
ПУБЛІЧНЕ УПРАВЛІННЯ ТА АДМІНІСТРУВАННЯ

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Oliynyk Oleksandr

Candidate of Philosophy, Associate Professor,
Zaporizhzhia National University

ORCID: <https://orcid.org/0000-0003-0511-7681>

Олійник О.М.

Запорізький національний університет

INTERNATIONAL EXPERIENCE OF STATE REGULATION OF THE FOOD INDUSTRY IN THE CONTEXT OF DIGITAL TRANSFORMATION

МІЖНАРОДНИЙ ДОСВІД ДЕРЖАВНОГО РЕГУЛЮВАННЯ ХАРЧОВОЇ ГАЛУЗІ В КОНТЕКСТІ ЦИФРОВОЇ ТРАНСФОРМАЦІЇ

The article is devoted to researching the international experience of state regulation of the food industry in the conditions of digital transformation and determining ways of its adaptation to Ukrainian realities. The experience of the EU, the USA, China, Canada, Australia and India in the application of digital transformation technologies and innovations in the state regulation of food business was studied. The key factors for the successful implementation of digital technologies in the regulatory mechanisms of the food industry have been identified, including: the creation of a legal framework, investment in the development of digital infrastructure, increasing the digital literacy of employees and consumers, as well as cooperation between state bodies. The results of the conducted research emphasize the need for an integrated approach combining technological innovation, cooperation between governments, industry and scientific institutions, as well as strict quality standards. The integration of advanced technologies and partnerships between the government and the private sector are key elements for the sustainable development of the food industry.

Keywords: food industry, digital transformation, international experience, state regulation, regulatory framework.

Стаття присвячена дослідженню міжнародного досвіду державного регулювання харчової промисловості в умовах цифрової трансформації та визначення шляхів його адаптації до українських реалій. Визначено, що світовими викликами для регулювання діяльності харчового бізнесу в умовах цифровізації є кібербезпека і захист даних, стандарти безпеки під час доставки і зберігання продуктів. Проведено аналіз міжнародних практик державного регулювання харчової галузі, зокрема, зосереджено увагу на питанні використання цифрових технологій. Досліджено досвід ЄС, США, Китаю, Канади, Австралії та Індії щодо у застосуванні технологій цифрової трансформації та інновацій у державному регулюванні харчового бізнесу. Визначено переваги та недоліки американської, європейської та китайської моделей державного регулювання електронної комерції та харчового бізнесу. Особливу увагу приділено регуляторним механізмам, що забезпечують захист даних та цифрових систем від загроз, а також стандартизації електронного маркування та відстеження продуктів. Визначено ключові фактори успішного впровадження цифрових технологій у регуляторні механізми харчової промисловості, серед яких: створення правових рамок, інвестування у розвиток цифрової інфраструктури, підвищення цифрової грамотності працівників та споживачів, а також співпраця між державними органами. Визначено переваги та недоліки застосування технологій електронної комерції у міжнародній практиці державного регулювання харчової промисловості. Результати проведеного дослідження підкреслюють необхідність комплексного підходу, що поєднує технологічні інновації, співпрацю між урядами, промисловістю та науковими

установами, а також суворі стандарти якості. Такий підхід сприяє забезпеченню безпеки та якості харчових продуктів і сталому розвитку галузі. Інтеграція передових технологій та партнерство між урядом і приватним сектором є ключовими елементами для стійкого розвитку харчової промисловості. Україні варто спрямувати зусилля на створення сприятливих умов для інновацій та розвитку сучасних технологій, що підвищить її конкурентоспроможність на міжнародному ринку.

Ключові слова: харчова промисловість, цифрова трансформація, міжнародний досвіт, державне регулювання, регуляторна схема.

Formulation of the problem. Globalization and the rapid development of digital technologies demand updated approaches to state regulation of the food industry. The growth of online trade and the use of digital technologies create new challenges, including enhanced cybersecurity, the protection of consumers' personal data, and adherence to safety standards during product delivery and storage. In the context of digital transformation, the government must develop and implement effective legal frameworks and regulatory mechanisms that address modern challenges, taking into account international experience. Analyzing international experience will not only help identify effective regulatory models but also understand which technological innovations can be successfully integrated into the domestic food industry.

Analysis of recent research and publications. The issue of digital transformation in the food industry has been addressed by Karkovska V.Ya. and Dziurakh Yu.M. [1], as well as Berher A.D. [2]. The international experience of food industry regulation, modern requirements, and trends in state management of the industry have been studied by the following researchers: Tertychnyi Ya.S. [3], Kordzaia N.R. [4], Mostova A.D. [5], Fera-Klemontsa O.Yu. [6], Tkachuk H.O. [7], Skrypchuk P.M., Khomenko A.Ie. [8], Lushpaiev S.O. [9] and Shoiko V.A. [10].

Formulation of the purpose of the article. The aim of the article is to study international experiences in state regulation of the food industry under conditions of digital transformation and to determine ways of adapting this experience to Ukrainian realities.

Presenting of the main material. Digital transformation is an integral part of the modern development of the food industry worldwide. State regulation in this sphere is aimed at ensuring high standards of quality and safety of food products, as well as adapting the latest technologies for the effective operation of the industry. International experience demonstrates that the integration of digital technologies into the food industry enhances transparency, efficiency, and competitiveness. Analyzing international experiences in state regulation of the food industry will allow us to identify effective models of state regulation in the food industry that can be adapted in Ukraine.

Let's consider the global trends in the regulation of the food industry in the context of digital transformation (Fig. 1).

According to the data in Fig. 1, global trends in food industry regulation in the context of digital transformation aim to improve product quality and safety, stimulate innovation, and ensure cybersecurity. A significant step is the standardization of electronic labeling, which promotes transparency and traceability of food products on a global scale. This provides consumers with greater confidence in the quality of the products they purchase. Innovations in online trading are encouraged through the development of regulatory mechanisms that not only support the advancement of new technologies but also ensure their safety. Implementing cybersecurity measures is critically important for protecting data and digital systems from potential threats, ensuring the stable operation of all participants in the supply chain. The development of IoT in production and supply allows the use of sensors and connected devices for continuous product monitoring, enhancing supply chain management efficiency and reducing risks. Using artificial intelligence for product quality and safety control automates processes and detects potential threats at early stages, significantly increasing the overall level of food safety. The identified trends indicate that digital transformation in the food

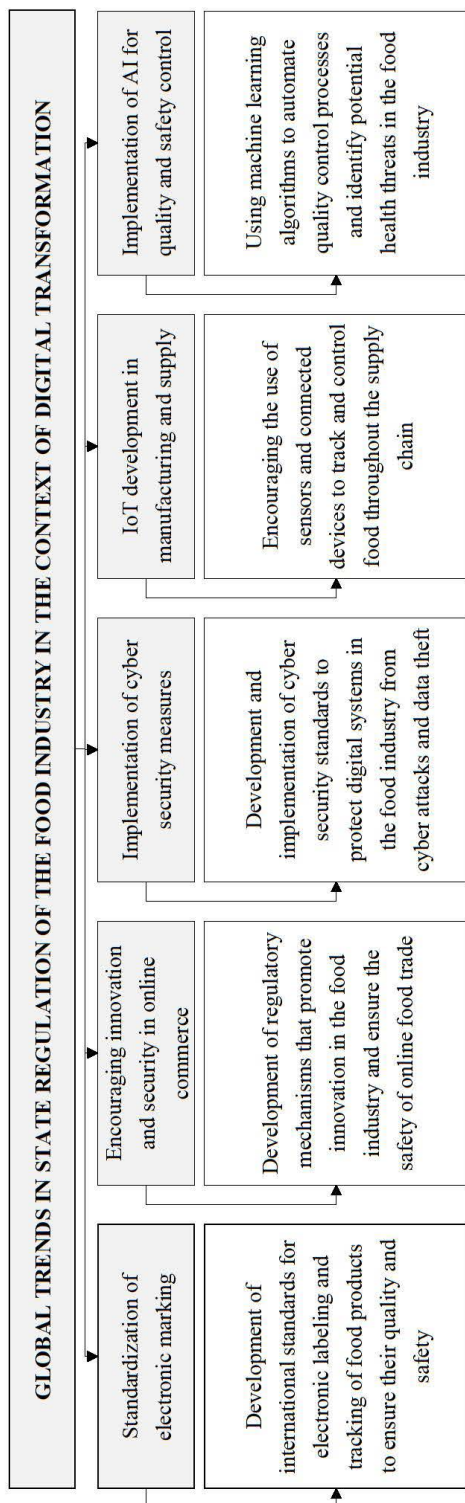


Figure 1. Global trends in the regulation of the food industry in the context of digital transformation

Source: formed based on sources [1–3]

industry is a multifaceted process requiring synchronized efforts at an international level. The integration of advanced technologies and strict regulatory standards ensures a more transparent, safe, and efficient food supply chain. The successful implementation of these trends depends on active collaboration between governments, industry, and scientific institutions, creating a foundation for sustainable development of the food industry in the digital era.

Let's consider the international tools for state regulation of the food industry (Fig. 2). According to the data in Fig. 2, international experience in regulating the food industry demonstrates the importance of implementing digital technologies and partnerships to achieve high standards of quality and safety. Digital certification and licensing systems, which streamline the market entry of new products, ensure efficiency and transparency of processes. Meanwhile, collaboration with industry and academic institutions allows governments to develop and implement innovations that meet the current and future needs of the sector. A crucial aspect is the establishment of international quality and safety standards for food products, supported by organizations such as the World Health Organization. This provides unified criteria for different countries and enhances consumer trust. The use of technologies such as RFID for electronic labeling and product tracking significantly improves supply chain transparency, allowing consumers to trace the product's journey from producer to table. This not only increases trust in products but also reduces risks associated with food safety.

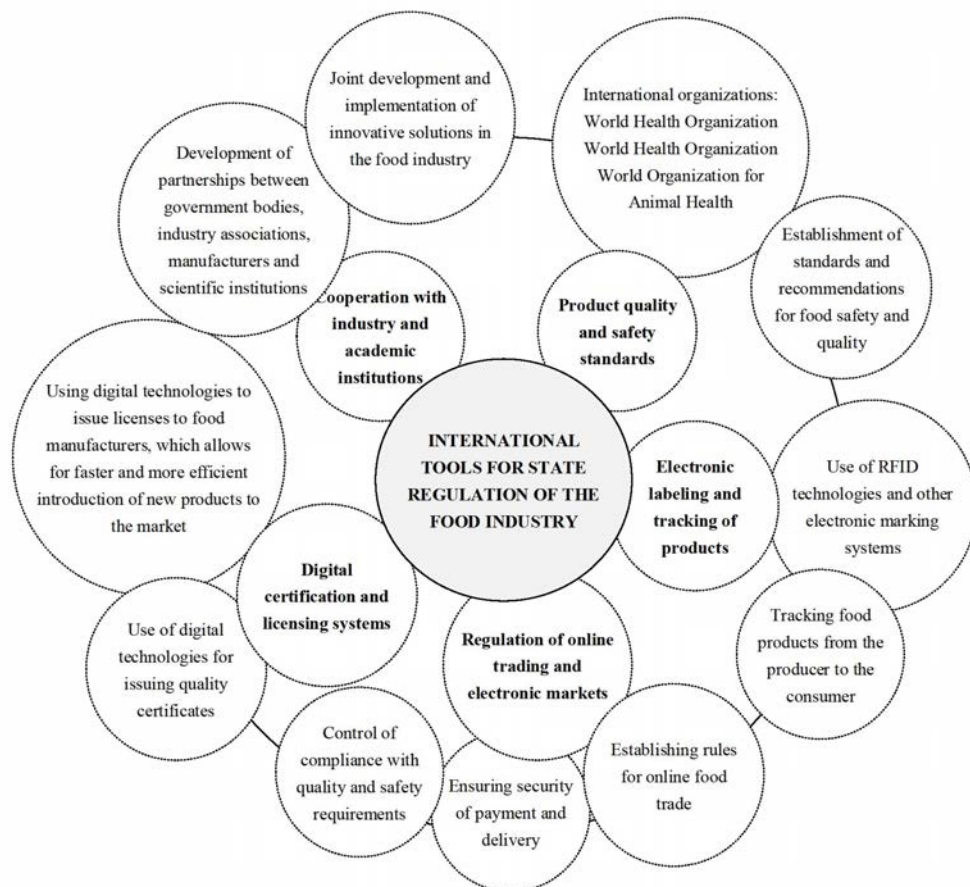


Figure 2. International tools for state regulation of the food industry

Source: formed based on sources [4–10]

Regulating online trade and electronic markets (Fig. 2) adds an additional layer of protection by establishing clear rules to ensure payment security, delivery, and compliance with quality standards. This is particularly crucial amidst the rapid growth of online food sales, which necessitates effective monitoring and regulation. Overall, international regulatory tools in the food industry underscore the need for a comprehensive approach that integrates technological innovations, collaboration across sectors, and stringent quality standards. Such an approach not only ensures the safety and quality of food products but also promotes sustainable development in the face of globalization and increasing demand.

Let's consider the international problems of state regulation of the food industry in the context of digital transformation and determine ways to solve them (Fig. 3).

As seen from the data in Fig. 3, the digital transformation of the food industry opens new horizons but also presents several serious challenges. The increase in data exchange in online commerce raises concerns about the security of consumers' personal information, and the growing use of digital technologies leads to heightened cybersecurity threats and cybercrime. Ensuring the quality and safety of products becomes more complex in the context of internet commerce, requiring improvements in legal frameworks and regulation.



Figure 3. The international problems of state regulation of the food industry in the context of digital transformation and determine ways to solve them

Source: formed based on sources [1–10]

Additionally, ensuring the accessibility of online platforms for all segments of the population is a key task. To address these issues, it is necessary to develop and implement data security and cybersecurity standards that will guarantee the protection of information and networks in the food industry.

The implementation of technologies opens new opportunities for improving efficiency and transparency. Regulators must update legal frameworks to meet the demands of the digital age, including provisions for e-commerce and cybersecurity. Educating and training consumers and entrepreneurs on digital security can help reduce the risks associated with digital transformation. Government bodies should encourage innovation by providing financial support for projects that enhance the safety, quality, and accessibility of food products. Equally important is the partnership between the government and the private sector in developing and implementing effective regulatory strategies.

On the one hand, technological advancements bring new opportunities, but on the other hand, they create new challenges that require careful regulation and cooperation among various stakeholders. Only through a balanced combination of innovation and strict standards can sustainable development of the food industry in the digital age be achieved.

Let's consider the practices of the countries of the world regarding the use of electronic commerce technologies in the food industry (Fig. 4).

As seen from the data in Fig. 4, the European Union is betting on blockchain technology through the "European Chain" program, which allows tracking the origin and quality of products such as olive oil. This helps increase consumer confidence in product quality. In the United States, programs like "Precision Agriculture" optimize agricultural processes using modern technologies. Additionally, the Centers for Disease Control and Prevention (CDC) utilizes digital technologies to monitor food poisoning, allowing for quick responses to potential safety threats.

China is investing in artificial intelligence and big data research to improve production efficiency and quality control of food products. This ensures more precise control over production processes and guarantees high product quality. Canada is implementing the Digital Technology Adoption Pilot Program, which promotes the use of modern technologies to enhance product efficiency and safety. This helps Canadian producers remain competitive in the global market. Australia employs blockchain and RFID technologies through the National Food Traceability Framework program to track food products from supplier to consumer, ensuring high transparency and product safety. In India, mobile applications and online platforms are being developed to provide farmers with access to weather information, market prices, and best agricultural practices, enhancing productivity and income stability for rural farmers.

The research results show that the implementation of digital technologies in various countries contributes to improving the quality and safety of food products. Innovative solutions help protect consumers, increase production efficiency, and maintain competitiveness in the global market. Each of the studied countries (Fig. 4) adapts technologies according to their specific needs, allowing for the most efficient use of resources and addressing the challenges of the modern agricultural sector.

Let's consider the advantages and disadvantages of the American, European, and Chinese models of state regulation of e-commerce and the food business, shown in Fig. 5.

According to the data in Fig. 5, each of the studied models of state regulation of e-commerce has its unique advantages and disadvantages, which significantly impact business development and consumer protection. The American model is characterized by minimal government intervention, which stimulates innovation and competition. This promotes business growth and attracts investment, making the U.S. a hub for leading e-commerce platforms. However, the lack of strict regulation creates risks for consumers and can lead to abuses by large corporations, complicating the activities of smaller companies. In contrast, the Chinese model is marked by a high level of institutional control, ensuring stability and

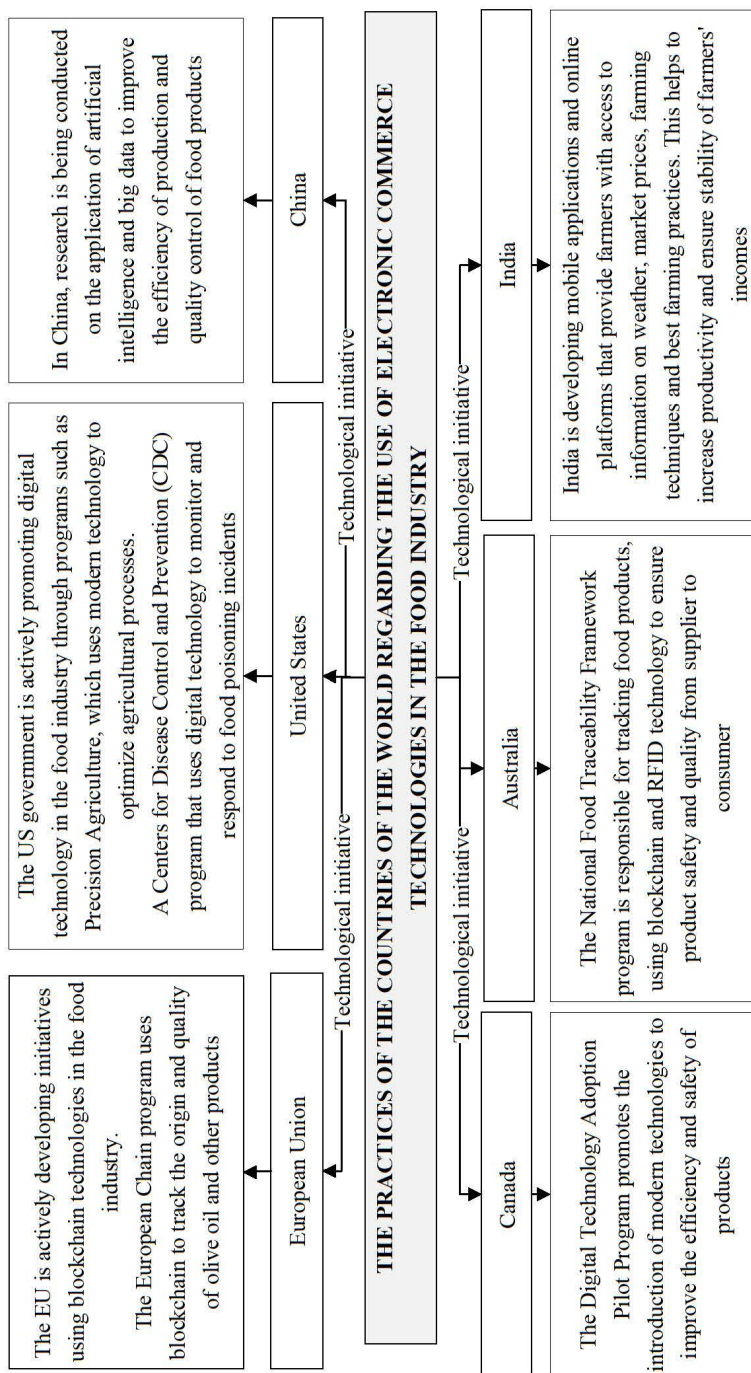


Figure 4. The practices of the countries of the world regarding the use of electronic commerce technologies in the food industry
Source: formed based on sources [1–3; 8; 9]

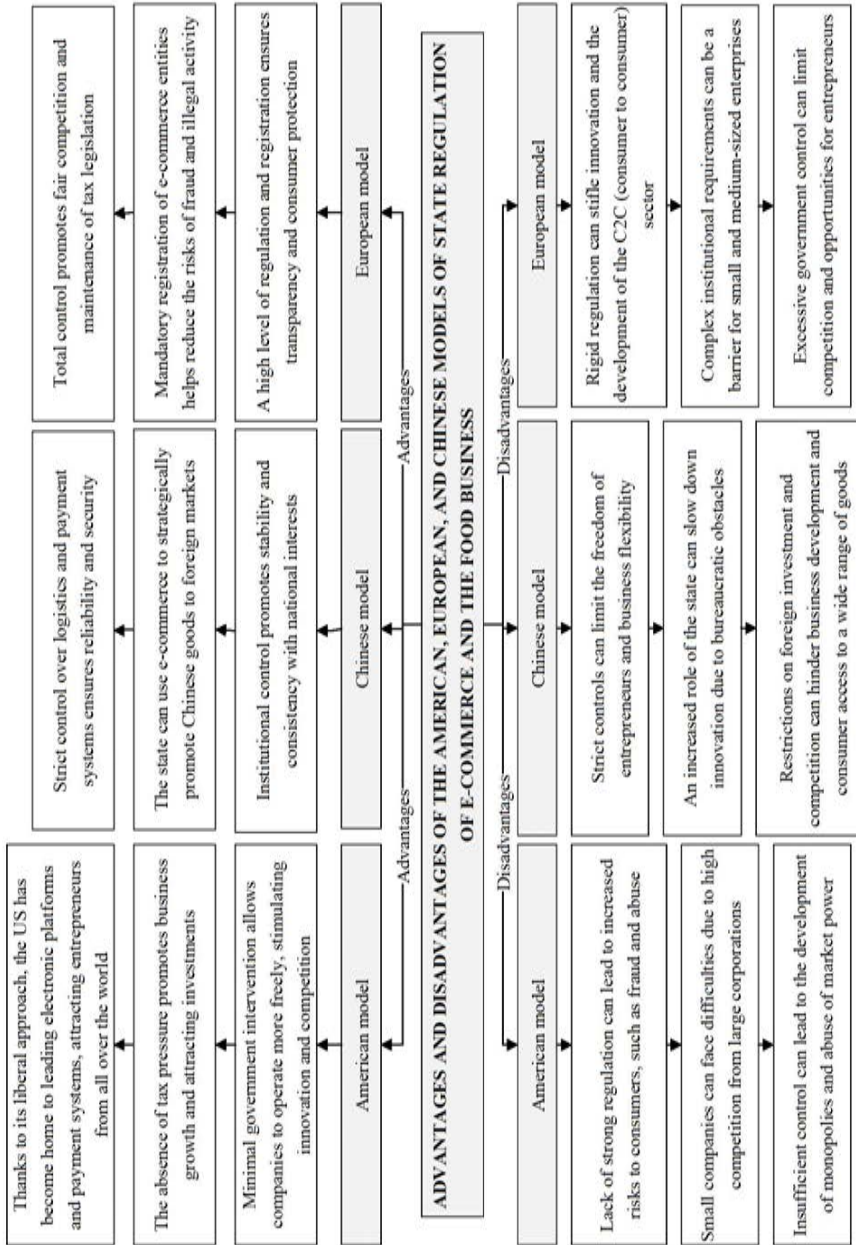


Figure 5. Advantages and disadvantages of the American, European, and Chinese models of state regulation of e-commerce and the food business
 Source: formed based on sources [1–3; 8; 9]

security. The state actively uses e-commerce to promote national products. However, strict control limits entrepreneurial freedom, stifles innovation, and creates barriers for foreign investment. The European model focuses on a high level of regulation and registration, promoting transparency and consumer protection. This approach reduces the risks of fraud and supports fair competition. However, strict regulation can limit innovation and the development of the C2C sector, and complex institutional requirements create barriers for small and medium-sized enterprises. Therefore, the effectiveness of e-commerce regulation largely depends on the balance between government control and entrepreneurial freedom. Each model has its strengths that can be leveraged to achieve specific goals, but the drawbacks must also be considered to ensure sustainable development of the industry.

Let's examine the advanced e-commerce technologies used in international practices for state regulation of the food industry (Fig. 6).

As seen from the data in Fig. 6, the presented e-commerce technologies in the regulation of the food industry show that each has its own features. For example, IBM Food Trust, through blockchain technologies, creates a transparent and immutable supply chain, allowing participants to share data about the origin and movement of products, which increases consumer trust and reduces the risks of counterfeit products. The RASFF in the EU ensures a quick response to food threats, enhancing consumer health protection through rapid information exchange about food and feed risks. QR codes in China provide consumers with detailed product information, improving quality management and increasing trust in brands. E-commerce in India's agricultural sector minimizes the need for intermediaries, reduces logistics and distribution costs, increases farmers' incomes, and provides consumers with fresh products.

Smart Farming in the Netherlands uses data to optimize production, irrigation, and fertilization, enhancing productivity and resource efficiency while reducing environmental impact. The Trace Register platform in the USA ensures transparency in the seafood supply chain, combats illegal fishing, and increases consumer trust in seafood products.

Let's consider the international practices of state regulation of the food industry with the use of electronic commerce technologies (Fig. 7).

According to the data in Fig. 7, regulatory schemes in the agricultural sector of different countries demonstrate a high level of integration of digital technologies to ensure transparency, safety, and efficiency in supply chains. IBM Food Trust uses blockchain to guarantee transparency and protect consumer data, complying with national and international regulatory requirements. In the EU, the RASFF system, integrated into legislation, ensures a rapid response to food safety threats, minimizing risks for consumers. China actively implements QR codes for quality control of food products, showcasing the effectiveness of national standards and regulations in maintaining international market competitiveness. India employs a comprehensive approach to regulating e-commerce in the agricultural sector, including legislative acts, government initiatives, and technological platforms. This ensures the transparent and efficient circulation of agricultural products, fostering the growth of domestic and international markets. The Netherlands, by implementing Smart Farming through government programs and legislation, enhances the efficiency and sustainability of agricultural production through the integration of high-tech solutions. In the USA, the Trace Register platform for seafood traceability ensures transparency in supply chains, which is crucial for maintaining consumer trust and complying with international standards.

Let's examine the advantages of applying e-commerce technologies in the international practice of state regulation of the food industry (Fig. 8).

As seen from the data in Fig. 8, the application of e-commerce technologies in the international practice of state regulation of the food industry demonstrates significant advantages for various aspects of the industry. Technologies such as blockchain, QR codes, and traceability platforms ensure transparency, increase consumer trust, and improve product quality management. IBM Food Trust and blockchain technology help reduce

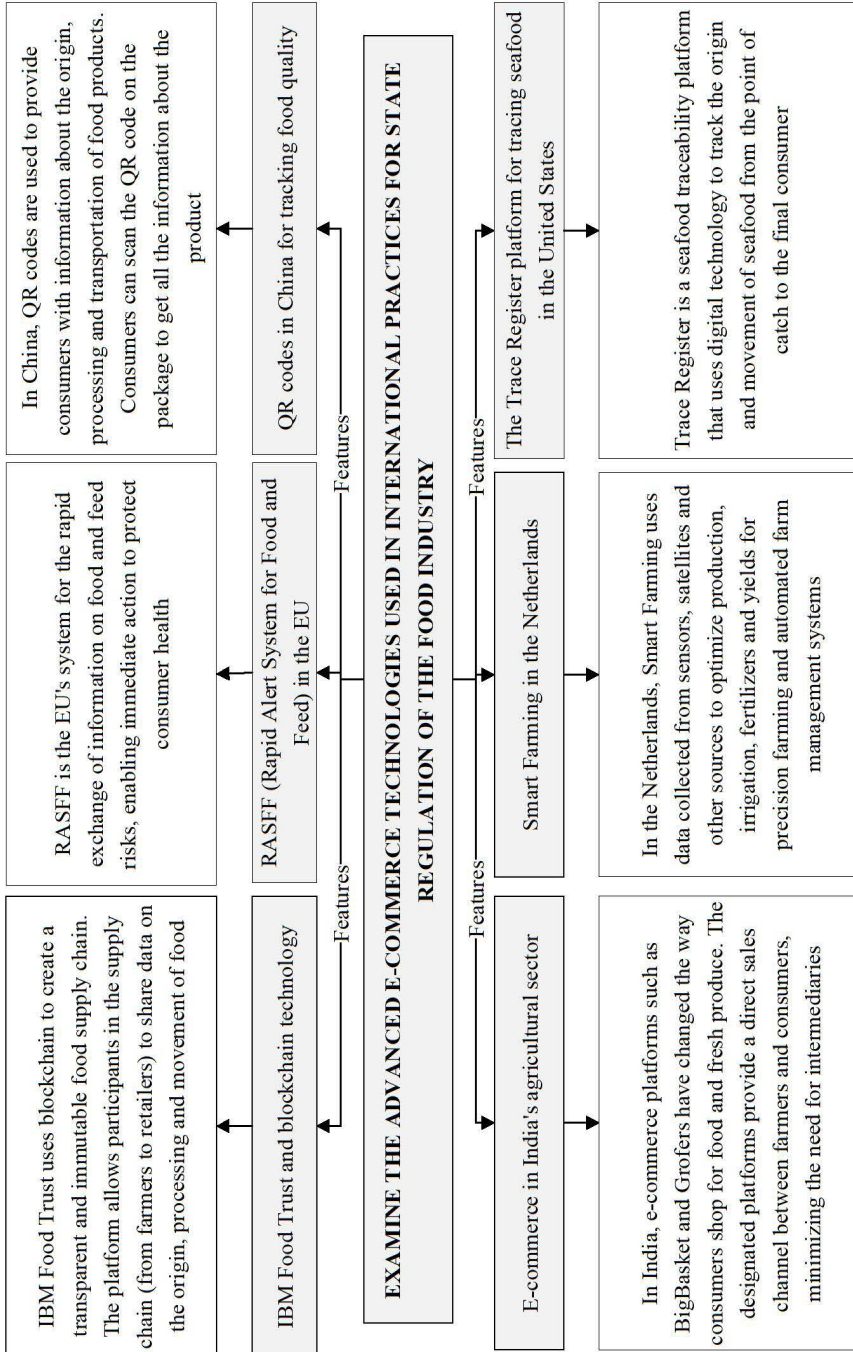


Figure 6. Examine the advanced e-commerce technologies used in international practices for state regulation of the food industry
Source: formed based on sources [1–3; 8; 9; 11–14]

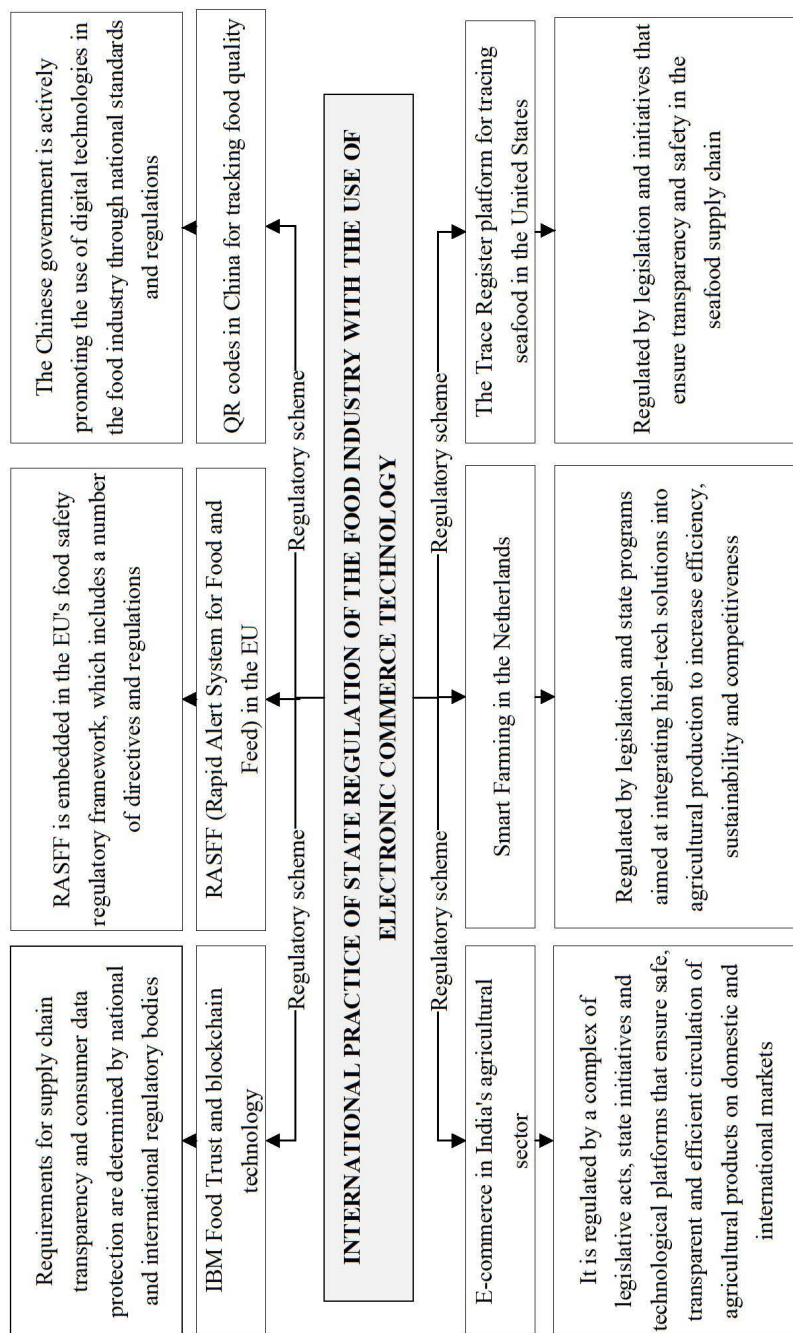


Figure 7. International practices of state regulation of the food industry with the use of electronic commerce technologies
 Source: formed based on sources [1–3; 8; 9; 11–14]

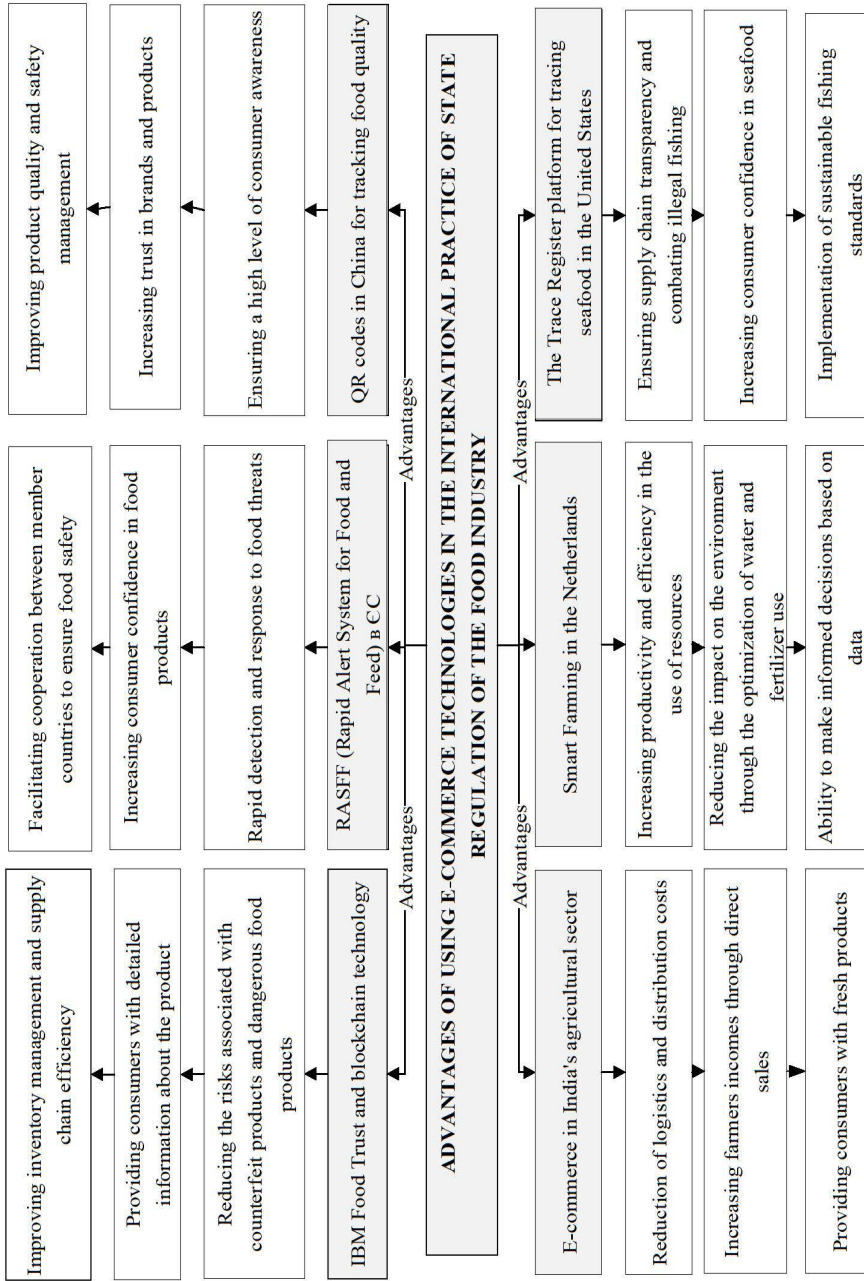


Figure 8. Advantages of using e-commerce technologies in the international practice of state regulation of the food industry
 Source: formed based on sources [1–3; 8; 9; 11–14]

the risks of counterfeit products and provide consumers with detailed information about the origin and quality of the product, improving inventory management and supply chain efficiency. The RASFF (Rapid Alert System for Food and Feed) in the EU ensures rapid detection and response to food threats, enhancing food safety and consumer trust. QR codes in China for tracking food quality provide a high level of consumer awareness and increase trust in brands and products, improving quality and safety management. E-commerce in India's agricultural sector reduces logistics and distribution costs, increases farmers' incomes through direct sales, and provides consumers with fresh products. Smart Farming in the Netherlands enhances productivity and resource efficiency, reduces environmental impact by optimizing water and fertilizer use, and enables data-driven decision-making.

The Trace Register platform for seafood traceability in the USA ensures supply chain transparency, combats illegal fishing, increases consumer trust in seafood, and promotes sustainable fishing standards. E-commerce technologies in the food industry contribute to the sustainable development of the sector by meeting consumer demands for product quality and safety, improving supply chain management, and enhancing production efficiency.

Let's consider the disadvantages of applying e-commerce technologies in the international practice of state regulation of the food industry (Fig. 9).

As seen from the data in Fig. 9, the cost of implementing the IBM Food Trust system can be high, posing a barrier for small businesses, especially in developing countries where financial resources are limited. Additionally, the use of QR codes in China may be ineffective in rural areas where access to technology is limited, complicating their widespread implementation. A similar situation may arise with e-commerce in India's agricultural sector due to the uneven levels of infrastructure and education.

The requirement for substantial initial investments in modern technologies can also be a challenge for farmers and entrepreneurs who may lack the necessary resources or knowledge for their implementation. In the given examples, each technology has its limitations and requires careful planning and adaptation for successful implementation. Thus, the implementation of digital technologies and regulatory mechanisms in the food industry across various countries aligns with global trends towards improving the quality and safety of food products. This approach not only protects consumers but also stimulates innovation and enhances competitiveness in the global market. Countries that actively integrate technologies into regulatory processes are better equipped to address the challenges of the modern agricultural sector.

Conclusions. Globalization and digitalization of the food industry require states to update their regulatory approaches to ensure the safety, quality, and efficiency of food production and supply. International experience demonstrates successful examples of implementing technologies such as blockchain for product traceability, artificial intelligence for quality and safety control, and RFID for supply chain monitoring. For Ukraine, it is crucial not only to adopt these technologies but also to adapt them to national conditions. A comprehensive approach that combines technological innovations, collaboration between governments, industry, and scientific institutions is necessary for the sustainable development of the sector. Practical recommendations for Ukraine include the implementation of data security standards, financial support for modernization projects in the food industry, and educational programs to raise awareness of digital technologies. Thus, effective state regulation based on the best international practices and adapted to local conditions will enhance the competitiveness of Ukraine's food industry in the global market, protect consumer rights, and promote the sustainable development of the sector. This will create conditions for safe and high-quality food production and supply, which is critically important in today's globalized and digitally transformed environment. However, for the effective implementation of such changes in Ukraine, it is necessary not only to adopt foreign experience but also to adapt it to local conditions, modernize physical and digital infrastructure, taking into account the specifics of the national food industry and consumer needs.

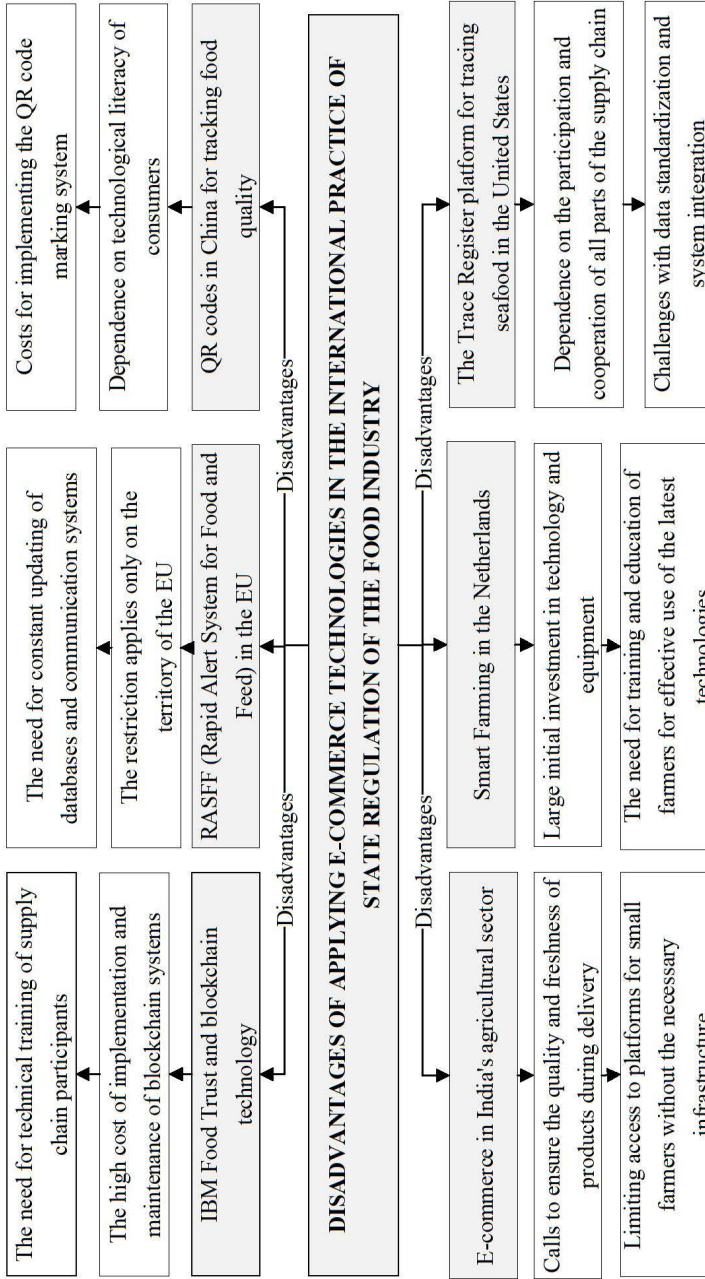


Figure 9. Disadvantages of applying e-commerce technologies in the international practice of state regulation of the food industry
Source: formed based on sources [1–3; 8; 9; 11–14]

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