УДК 338.432:339.564:004
DOI:10.37128/2707-5826-2023-4-6

APPLICATION OF ADVANCED TECHNOLOGIES IN AGRICULTURAL SECTOR FOR INCREASING GROSS PRODUCTION AND EXPORTING AGRICULTURAL PRODUCTS

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This scientific article examines the influence of information technologies on the agro-industrial complex (AIC) during armed conflicts, specifically using the example of the war in Ukraine. Military actions have a negative impact on agricultural activities, leading to the destruction of crops, railways, transportation blockades, and infrastructure. However, information technologies can play a crucial role in ensuring food security and supporting the AIC in the context of armed conflict.The article analyzes the utilization of information technologies such as remote sensing of Earth, geographic information systems, drones, and agricultural sensors, which can provide essential information about the state of crops, water resources, and land areas. These technologies assist farmers in planning and making informed decisions regarding optimal resource utilization and ensuring food security even during times of armed conflict.

Furthermore, the article examines the effectiveness of mobile applications, electronic document management, and farm management systems in ensuring efficient production and organizing agricultural processes to maintain the sustainable functioning of the AIC during armed conflict. These technologies enable farmers and agricultural enterprise managers to conduct effective monitoring and resource management, plan farm operations, and coordinate personnel actions even in the face of military threats.

Additionally, the article analyzes the ethical aspects of using information technologies in the AIC during armed conflicts. This includes issues of data confidentiality protection for farmers, ethical use of data from mobile applications, and the safeguarding of worker privacy. The impact of these technologies on society and rural development during conflicts is also explored.

Overall, the article provides a comprehensive view of the use of information technologies in agriculture during armed conflict and emphasizes the necessity of developing and implementing specialized solutions that address the unique challenges and needs of the AIC in such exceptional circumstances. Research in this field can contribute to ensuring the sustainable development of agriculture and enhancing the resilience of the AIC to armed conflicts and other hazards.

Keywords*: information technologies, artificial intelligence, agriculture, agro-industrial complex (AIC), armed conflict.*

Table 3. Fig. 6. Lit. 15.

Formulation of the problem. The utilization of information technologies and artificial intelligence (AI) in the agro-industrial complex (AIC) can have a significant impact on enhancing productivity, optimizing resources, and ensuring sustainable development. However, within the context of armed conflicts, such as the war in Ukraine, specific issues and challenges arise that need to be considered when applying these technologies in the AIC.

The first issue lies in the preservation and protection of information. Armed conflicts come with substantial risks to data security, as information systems and networks can be vulnerable to hacking attacks or destroyed due to military actions. This can lead to the loss of crucial information about agricultural land, crop yields, resource distribution, and other data necessary for effective AIC management.

The second issue is associated with physical destruction and infrastructure damage. Military actions can result in the destruction of agricultural infrastructure, including irrigation systems, transportation networks, processing areas, and grain storage facilities. This presents a challenge in restoring and re-establishing the functionality of agricultural enterprises and production processes [2].

The third problem relates to access to technology and education. Armed conflicts can limit access to cutting-edge technologies and informational resources in conflict-affected rural areas. Many rural inhabitants might be disconnected from the opportunities presented by information technologies and artificial intelligence due to lack of access to necessary equipment, inadequate cybersecurity, and insufficient awareness [2].

Moreover, there is the challenge of ensuring the efficiency and resilience of information systems during wartime conditions. Disruptions in communication networks, power supply interruptions, and insufficient personnel expertise can have a negative impact on the functioning of technological solutions and management systems.

It's also worth noting the issue of ensuring the stability and continuity of AIC operations during armed conflict. Conditions of wartime can pose risks to agricultural workers and may necessitate evacuations and interruptions in agricultural processes. This can result in crop losses, reduced production, and deteriorating economic indicators for the AIC.

Consequently, the crux of the problem lies in the necessity to develop and implement effective strategies for using information technologies and artificial intelligence in the agro-industrial complex during armed conflicts. Addressing these issues requires the development of specialized solutions that take into account the unique challenges and circumstances accompanying military actions [2].

Analysis of recent research and publications. An analysis of recent research and publications reveals that the application of information technologies and artificial intelligence in the agro-industrial complex (AIC) during armed conflicts is a relevant and promising research topic. Prominent domestic and international scholars have made a significant contribution to the development of issues related to the study of the application of information technologies and artificial intelligence in the AIC during armed conflicts. Notable researchers include N.L. Pravdiuk, V.V. Kozhukhar [7]; O.V. Lebid [5]; S.V. Kiporenko; V.V. Vovk [4]; Z. Ya. Shatska, V. I. Prima [11]; M. Bakin, O. V. Larchenko [2], and others.

Research methods. Various methods were employed in conducting research on the application of information technologies and artificial intelligence in the agro-industrial complex during armed conflicts. Here are several primary methods that were utilized: *Literature Analysis* (this involved studying existing scientific literature, publications, articles, and research related to the application of information technologies and artificial intelligence in the agro-industrial complex during armed conflicts. This method allowed for familiarizing with the current state of affairs in the field, identifying trends, and pinpointing gaps for further research). *Experimental Research* (this included the organization of specialized experiments where information technologies and artificial intelligence were applied in various scenarios of armed conflicts within the agro-industrial complex. These experiments involved testing software tools, agricultural sensors, farm management systems, and more). *Statistical Analysis* (This encompassed the collection and analysis of statistical data associated with the utilization of information technologies and artificial intelligence in the agro-industrial complex during armed conflicts. This method enabled the identification of relationships, trends, and the effectiveness of applying these technologies). In summary, these methods allowed researchers to comprehensively investigate the utilization of information technologies and artificial intelligence in the agro-industrial complex during armed conflicts, offering insights into their potential impact and effectiveness.

Presentation of the main research material. The application of information technologies and artificial intelligence in the agro-industrial complex (AIC) has a broad spectrum of applications that contribute to enhancing efficiency, productivity, and sustainability of agricultural production. The primary areas of application include (Fig. 1):

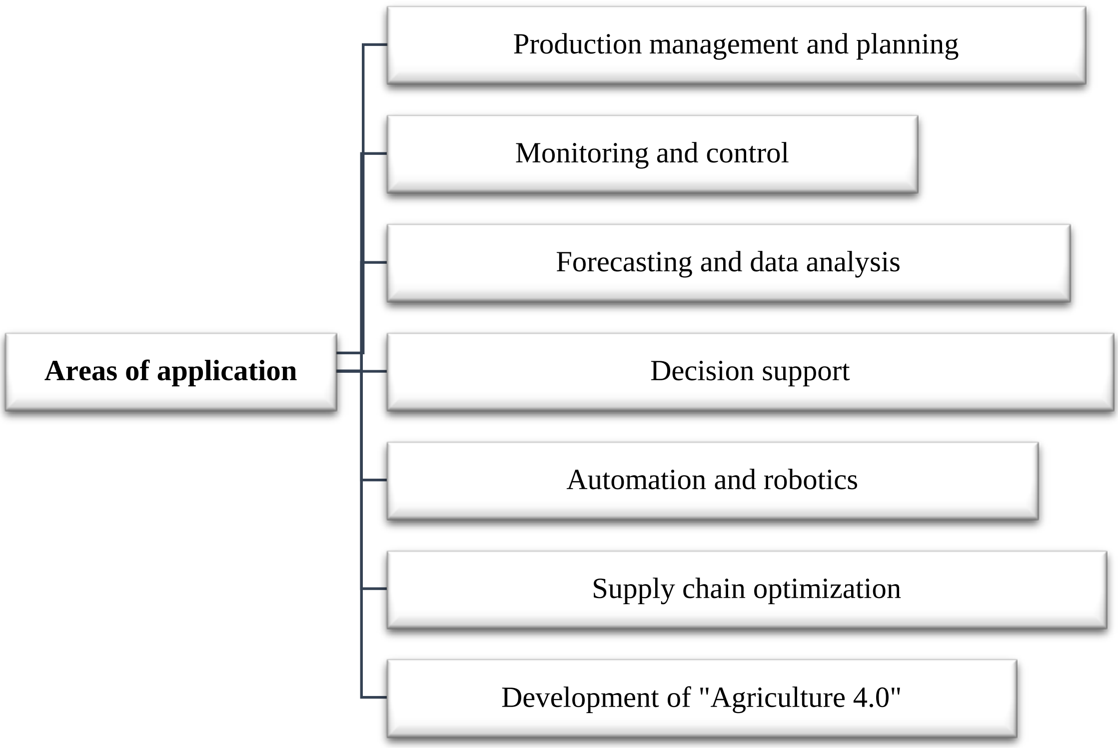

Fig. 1. Schematic representation of the application areas of information technologies in the AIC

Source: created by the authors

1. *Production Management and Planning*: Information technologies assist in effective farm management and enhance production planning processes. They enable digital processing and analysis of data concerning crops, plant growth, animal feeding, and resource monitoring, facilitating informed decision-making.

2. *Monitoring and Control*: The application of modern technologies allows continuous monitoring of agricultural land, encompassing the environment, plant health, soil and water quality, as well as animal well-being. Sensor systems, IoT solutions, and drones collect and analyze real-time data, enabling swift responses to changes and appropriate actions.

3. *Forecasting and Data Analysis*: Information technologies and artificial intelligence are employed for predicting crop yields, plant pests and diseases, weather-related risks, and market trends.

4. *Decision Support*: Information technologies and artificial intelligence aid agricultural producers in making informed decisions. They analyze data related to crop profitability, optimal resource utilization, selection of best agricultural practices, and workforce distribution.

5. *Automation and Robotics*: Information technologies allow for the automation of processes in the agricultural complex. Robots and autonomous machines can perform tasks such as harvesting, soil cultivation, irrigation, animal feeding, and other routine chores. This reduces reliance on manual labor and improves productivity.

6. *Supply Chain Optimization*: Information technologies enhance supply chain management within the agricultural complex. Digital tracking and identification systems facilitate tracing products from seeding to end consumers, ensuring product quality and safety, while also enhancing logistics efficiency and distribution.

7. *Development of "Agriculture 4.0"*: The application of information technologies and artificial intelligence in the AIC contributes to the development of the "Agriculture 4.0" concept. This concept entails the use of modern technologies to enhance productivity.

Ukraine employs diverse technologies in its agricultural complex, including equipment tracking, resource management control, parallel driving systems, satellite field monitoring, aerial photography, irrigation management, autopiloting, and differentiated application for agricultural machinery. However, successful integration of these innovations into the agricultural sector requires favorable conditions.

Before implementing information systems in agribusiness, it's crucial to carefully plan business processes, considering the company's management structure, technology capabilities, and employee competence. This may take significant time and necessitate systematic preparation. Without such prior planning and preparation, implemented information systems might prove ineffective, leading to dissatisfaction and discontinuation of technology use.

Therefore, for successful implementation of information technologies, it's important to enhance users' technological competence, provide preliminary training, and demonstrate the capabilities of new systems. This helps alleviate stress and facilitates the adoption of innovations. Continuous user training and support are essential elements for the successful integration of technologies into Ukraine's agricultural complex.

For many years, the Ukrainian agricultural complex held prominent positions among global exporters, until the Russian Federation's invasion. In 2021, agricultural production accounted for 40% of Ukraine's total export volume.

Full-scale war has become a significant ordeal for Ukrainian agrarians. The invasion led to the destruction of long-term processes and logistical chains. Many planting territories were mined, some restricted in access, and equipment and warehouses were destroyed. However, Ukrainian agrarians displayed incredible courage, and even during the most dreadful period of the war, they initiated the planting season this spring. The agribusiness sector actively works on restoring logistics and collaborating with international markets, while also expanding production in the western part of the country. Nevertheless, the war persists, and for every business, including agriculture, it's crucial to possess reliable tools that simplify operations in crisis conditions, help identify risks, and even protect land parcels and the company as a whole from raiding and bankruptcy [3].

According to scientists' forecasts, a decrease in the volume of gross agricultural production in Ukraine can be expected. Specifically, in 2023, this figure will decrease by 2.1% compared to 2022. This was reported by the director of the National Scientific Center "Institute of Agrarian Economics" and academician of the National Academy of Agrarian Sciences of Ukraine, Yuri Lupenko [9]. While presenting the latest development of the scientific team regarding the forecast of agricultural production in Ukraine for 2023, he emphasized the issues associated with economic decline and the continuation of the war. The low comparison base with 2022, when gross agricultural production decreased by a quarter, contributes to explaining the relatively small size of the production decline. The drop in agricultural production is linked to logistic problems of exporting agricultural products and a decrease in purchase prices, compelling agricultural producers to reduce production of the most productive types of crops, including wheat and corn. Loss of income for agricultural enterprises in 2022, significant cost increases of resources, and the complexity of procuring high-quality seed material and sufficient quantities of mineral fertilizers and plant protection substances complicate the technological process of plant cultivation [3].

Table 1 presents statistical data on the export of cereals, legumes (including processed products), and flour from Ukraine, in thousands of tons as of 31.05.2023.

Based on this table, the following conclusions can be drawn: in the 2022/23 marketing year, the total volume of cultivated agricultural crops amounted to 45,290 thousand tons, which is less than in the previous marketing year 2021/22 when 47,011 thousand tons were cultivated. Specifically, in May 2023, 3,403 thousand tons of agricultural crops were grown, whereas in May 2022, 1,142 thousand tons were grown. Among cereals and legumes, corn is the largest crop with a cultivated volume of 26,868 thousand tons in the 2022/23 marketing year, exceeding the volume grown in the previous marketing year (22,295 thousand tons). The export of agricultural products (grain + flour) in the 2022/23 marketing year reached 45,478 thousand tons, which is higher than the previous marketing year (47,106 thousand tons). In May 2023, exports amounted to 3,422 thousand tons, compared to 1,144 thousand tons in May 2022. The production volume of wheat flour in the 2022/23 marketing year was 136.0 thousand tons, compared to 69.4 thousand tons in the previous marketing year. In May 2023, 13.3 thousand tons of wheat flour were produced, compared to 1.4 thousand tons in May 2022. Production of other flour also increased in the 2022/23 marketing year to 5.5 thousand tons, compared to 1.6 thousand tons in the previous marketing year. In May 2023, 0.5 thousand tons of other flour were produced, compared to 0.1 thousand tons in May 2022. The overall volume of produced flour (converted to grain) in the 2022/23 marketing year was 141.5 thousand tons, an increase compared to 71.0 thousand tons in the previous marketing year. In May 2023, 18.4 thousand tons of flour were produced, compared to 1.5 thousand tons in May 2022.

Table 1

Export of cereals, legumes (including processed products), and flour, in thousands of tons as of 31.05. 2023

Agricultural crops	2022/2023		2021/2022	
	Just	In particular: in May-2023	Just	In particular: in May-2022
Cereals and legumes, total	45290	3403	47011	1142
wheat	15442	1044	18570	44
barley	2647	182	5679	11
wheat	17,9	0	161,9	0
corn	26868	2170	22295	1084
Wheat flour, thousand tons tone	136,0	13,3	69,4	1,4
Other flour, thousand tons tone	5,5	0,5	1,6	0,1
Flour together, thousand tons tone in terms of grain, thousand tons. tone	141,5 188,7	13,8 18,4	71,0 94,7	1,5 2
Export together (grain + flour)	45478	3422	47106	1144

Source: Compiled based on data from the State Customs Service and the Ministry of Agrarian Policy [3]

In the current year, Ukrainian exports of goods continue to be highly concentrated in regional structures, particularly in the European Union ($ 3.671 billion), Asian countries ($ 2.449 billion), Africa ($ 345 million), and the CIS ($ 155 million) (Fig.2). Altogether, these four geographical regions account for 98% of the agricultural products consumed, produced in Ukraine. China remains the top importer, purchasing Ukrainian food products worth $ 986 million. Other countries within the top 10 importers include Romania ($ 828 million), Turkey ($ 759 million), Poland ($ 666 million), the Netherlands ($ 381 million), Spain ($ 379 million), Hungary ($ 268 million), Italy ($ 256 million), Germany ($ 154 million), and Egypt ($ 149 million) (Fig.3). Collectively, these ten countries contribute to 71% of the profit from Ukraine's agricultural product exports [1].

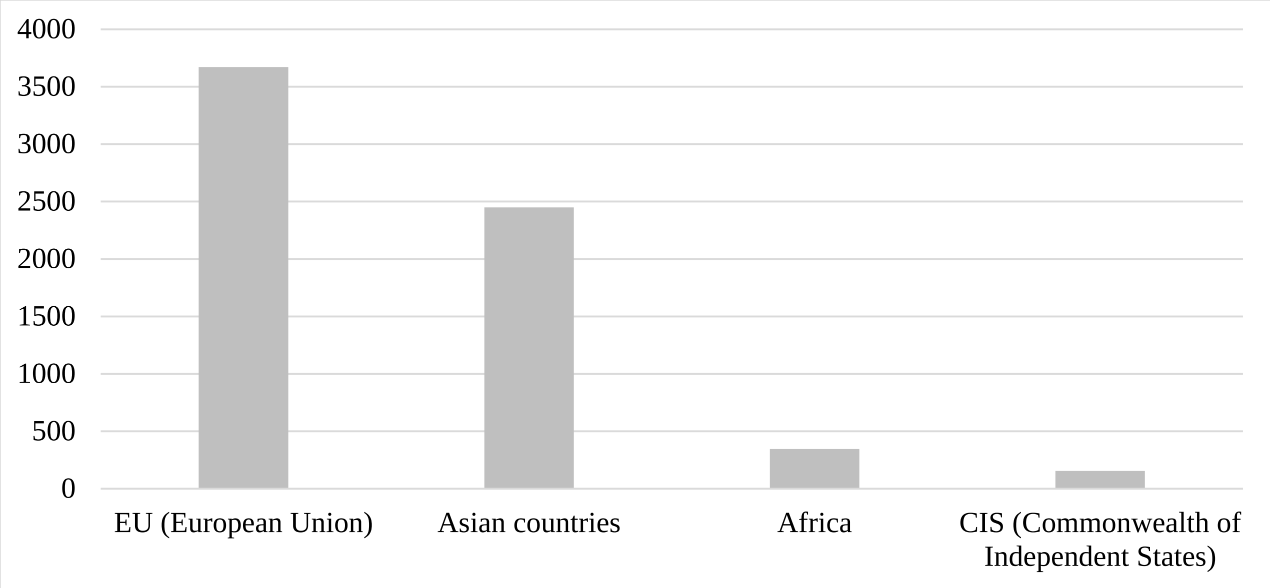

Fig.2 Export of products in 2023, million $
Source: constructed by the authors

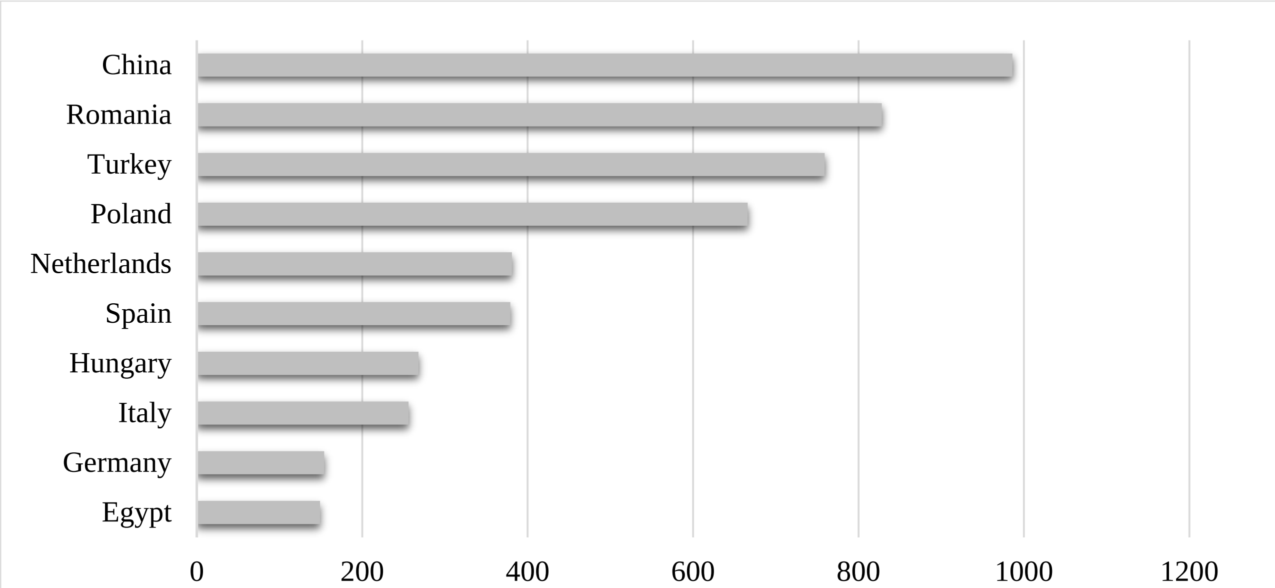

Fig.3 Top 10 importers of Ukrainian products in 2023, million US dollars
Source: constructed by the authors

In addition, artificial intelligence (AI) is used for the dynamic application of mineral and organic fertilizers to increase nutrient efficiency, reduce environmental pollution risks, and enhance crop yields.

One approach to using AI in the dynamic application of fertilizers involves using sensors to collect data on the condition of plants, soil, and the surrounding environment. This data can then be used to create a model that predicts the nutritional needs of plants. This model can be used to automatically adjust the dosage of fertilizers according to the needs of the plants.

Another approach to using AI in the dynamic application of fertilizers is to use machine learning to analyze historical data on crop yields, fertilizer application, and weather conditions. This data can be used to create a model that predicts crop yields based on various factors, including fertilizer application. This model can be used to develop recommendations for fertilizer application that will contribute to increased crop yields. Below are some specific examples of AI use in the dynamic application of fertilizers:

- **Yara** has developed a system called Yara N-sensor, which uses sensors to measure the nitrogen content in plant leaves. This information is used to make recommendations for the application of nitrogen fertilizers.
- **Raven** has developed a system called Raven Precision Planting, which uses satellite navigation and sensors for precise fertilizer delivery to fields.
- **BASF** has developed a system called BASF Crop Insights, which uses machine learning to analyze data on crop yields, fertilizer application, and weather conditions. This data is used to create recommendations for fertilizer application.

AI has the potential to significantly improve the efficiency of mineral and organic fertilizer use. The application of AI can help farmers improve crop yields, reduce fertilizer costs, and protect the environment.

The use of information technologies and artificial intelligence in agriculture plays a significant role in increasing product exports during times of war. To achieve this goal, it is necessary to utilize the following methods (table 2).

Table 2

Methods of using information technologies to increase product exports

Way	Description
Electronic trading platforms	The use of electronic trading platforms allows agricultural producers to direct to international buyers without being tied to intermediaries.
Production monitoring systems	Production monitoring systems allow agricultural producers to monitor production processes in real time, which allows them to more accurately plan production and predict export volumes.
Geomarketing Tools	Geomarketing tools allow you to identify potential markets and competitive situation in these regions. This allows you to focus on the most profitable export directions.
Electronic inventory management systems	Electronic inventory management systems allow you to more accurately predict the volume of production and exports of products, which reduces the risks of insufficient or excessive stocks of goods.
Video conferencing	Video conferencing allows remote communication with partners located on other continents. This allows you to reduce travel costs and communicate more effectively with buyers.
Electronic payments	Electronic payments allow fast and secure transactions, which reduces the risk of delays and fraud.
Email Marketing	E-marketing allows you to promote products in the markets, which is an important factor for increasing exports of agricultural products. Through email marketing, agricultural goods can be advanced on various online platforms and markets in different countries, providing access to new buyers and increasing the number of exported goods.

Source: compiled by the authors

These methods of using information technology help agricultural enterprises enhance the export of their products by ensuring efficient management, high quality, and reliable deliveries, as well as attracting new clients in external markets.

Bayer and Bosch have announced their collaboration in conducting joint research to develop Smart Spraying technology over the next three years. The goal of this technology is to ensure the most effective use of plant protection agents. Bosch is working on the development of high-efficiency sensors, analytical devices, and selective spraying systems. Meanwhile, Bayer leverages its expertise in geographic information systems (GIS) and the application of plant protection agents, along with developing algorithms for agronomic decisions and integrated pest management.

In Ukraine, the creation of information systems for agrarians is also gaining popularity. Even non-agricultural companies are involved in these developments. For example, in collaboration with the Ministry of Agrarian Policy and Food, Kyivstar has developed a test version of a specialized mobile application for Ukrainian agrarians. This digital platform provides information about product and material prices, data about pests, key agricultural news, weather information, and useful tips. The application aims to assist agricultural producers in conducting business, accessing information about state support programs, and receiving consultations, among other things [5].

Innovative projects that seemed impossible some time ago are now becoming a reality. One of such projects is field cultivation without direct human intervention. Scientists from Harper Adams University in the United Kingdom have completed a full cycle of farming operations, from planting to harvesting, using only unmanned technology. They successfully cultivated one hectare of barley on a farm in Shropshire. Tractors and combine harvesters were equipped with cameras, lasers, and GPS systems, enabling the machines to autonomously navigate and perform agricultural tasks. A fleet of drones was used for remote field monitoring, including soil sampling and planting information collection. Additionally, sensors for monitoring and automated plant spraying systems were installed on the plot.

Data analysis and machine learning hold significant potential for agricultural application. These technologies process vast amounts of data about plants and soil to make more accurate yield forecasts and create optimal conditions for each crop type. Machine learning also aids in detecting and predicting the spread of pests and plant diseases, enabling timely responses and prevention. These technologies enhance the efficiency of agricultural crop management and ensure stable and consistent yields.

Substantial advancements have also been achieved in the field of agricultural robotics and automation to enhance agricultural productivity. For instance, the use of expert systems allows for precise yield predictions and optimal growth conditions for different crop varieties. Information-extreme machine learning can be employed to create optimal conditions for plant growth and provide them with necessary resources. Considering the rapid development of technologies, educating students in agronomy and information technology holds great importance for the further advancement and refinement of agriculture [6].

Ukrainian agrarians are gaining a new tool for progressive development based on artificial intelligence. The latest technologies are increasingly penetrating the agricultural sector, reaching a new level today, including the integration of artificial intelligence. Recently, innovative companies in the Ukrainian agricultural market, "Agroscop International" and Innovation Agro Technologies, signed a memorandum of cooperation in February 2019 to implement the TARANIS project - "aerial reconnaissance" for agronomic field assessment [10].

The TARANIS project is an initiative dedicated to the development and implementation of advanced technologies for the agricultural sector. Its main goal is to apply "aerial reconnaissance" in agronomic field assessment. This project focuses on using drones, sensors, and analytical systems for data collection and analysis to optimize plant growth processes and increase crop yields. TARANIS provides agrarians with a new "intelligent" tool that assists in efficient agronomic field assessment and informed decision-making in agricultural production management.

Thanks to the TARANIS project, agrarians gain a convenient tool for monitoring and controlling the state of their fields. Drones equipped with specialized cameras and sensors conduct regular flights over fields, capturing high-quality images and data. These data are then analyzed using smart algorithms, enabling the identification of problematic areas, early detection of diseases and pests, and determining optimal timing for irrigation and fertilization [10].

One of the key advantages of the TARANIS project is providing timely information to agrarians. They receive detailed reports and recommendations for necessary actions to enhance yield and reduce risks. Moreover, the TARANIS system supports communication with experts and consultants who provide professional support and advice.

After a successful launch in Ukraine last year, the TARANIS system has already been applied on over 100,000 hectares of fields and has demonstrated its high accuracy. It utilizes artificial intelligence that continuously learns and is supported by large volumes of data encompassing various climatic zones and soil types worldwide.

The accumulated database includes information about various plant diseases, including tens of thousands of photographs depicting symptoms of these diseases from different angles, as well as details about nutrient deficiencies. The database also contains data about pests and weed species at different stages of development. Using this data, TARANIS provides the most precise identification of problematic areas in fields (Fig. 4-6).

As a result, it was identified that on a 400-hectare corn field, there was a significant growth of horsetail due to the unsuccessful use of a more economical herbicide. This led to losses estimated at least 20% of the total yield, equivalent to approximately $150,000. To immediately address this issue, a more expensive herbicide was applied, incurring a cost of $30,000. After calculating the total expenses, potential losses, and factoring in the cost of using the TARANIS system, it was found that the economic benefit amounted to around $110,000 to $120,000 [10, 13].

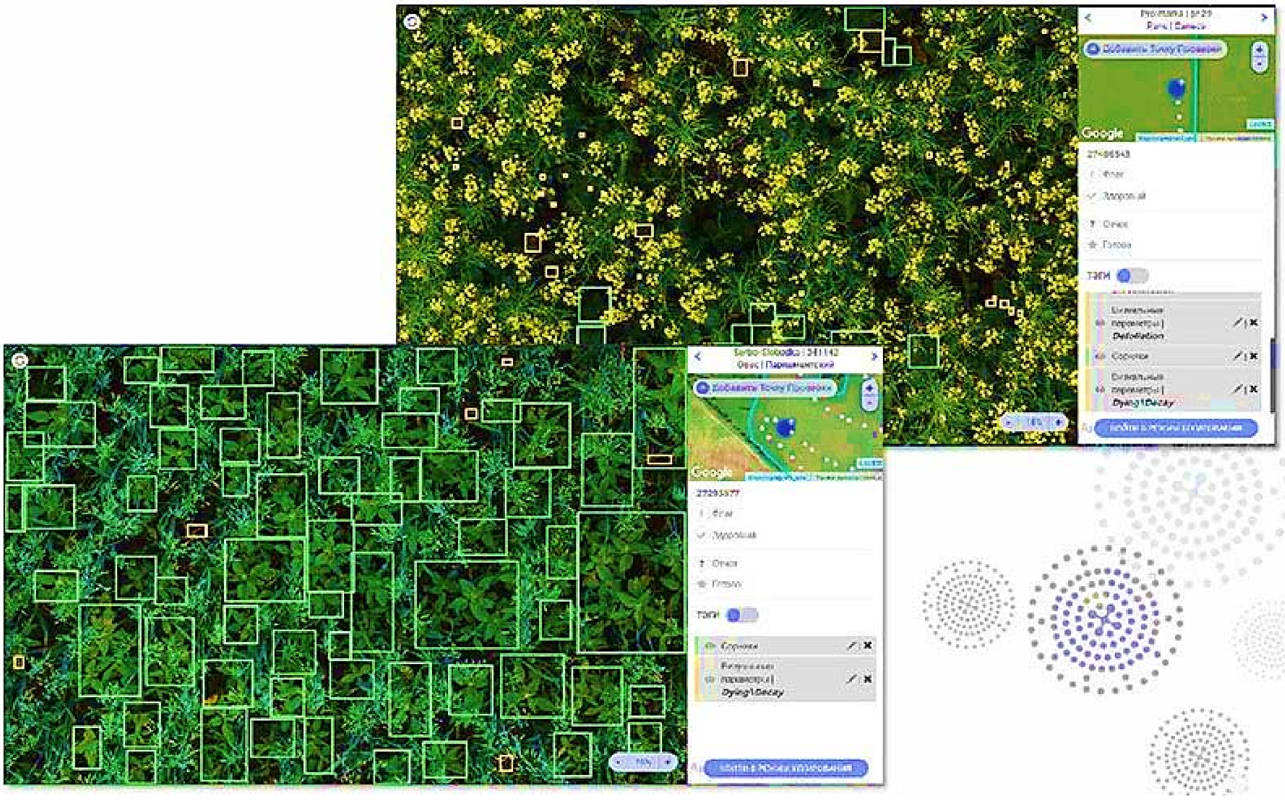

Fig. 4. Example of cognitive recognition of problematic areas in the fields
Source: [10]

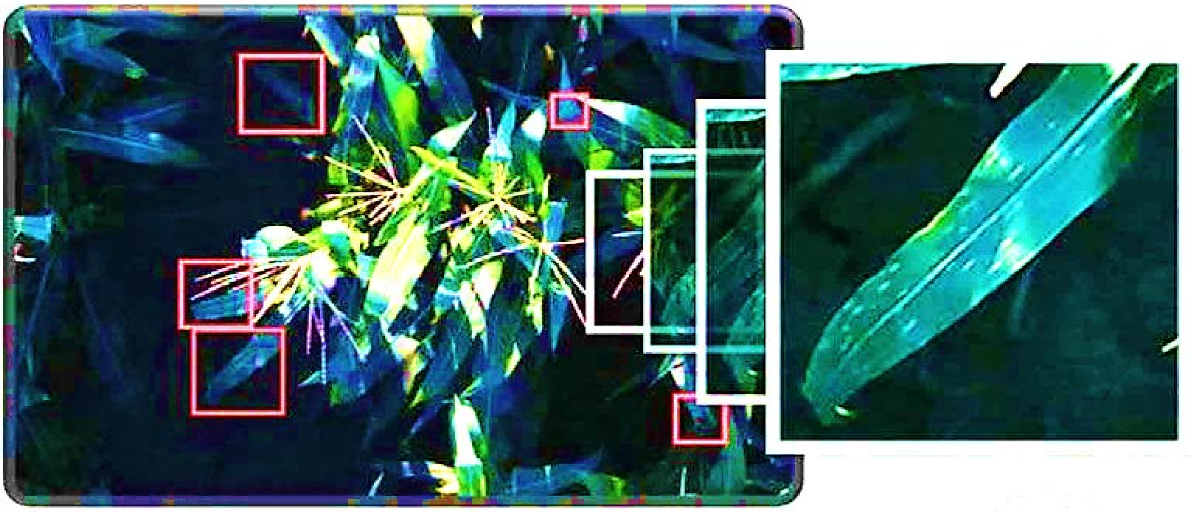

Fig. 5. Image from the field showing initial symptoms of corn leaf damage
Source: [10, 12]

Thus, the Israeli startup Taranis provides the opportunity to monitor the condition of plants, timely detect negative factors, and address them. Field sensor observation data, meteorological data, and aerial photography are utilized for monitoring. High-resolution images from Mavr with ultra-high resolution (up to 8 cm per pixel) are used for analysis. Analyzing large volumes of data allows for identifying areas with unnatural plant growth, identifying plant diseases, pest problems, assessing nutrient availability for plants, potential yield, and more.

Fig. 6. Example of generating reports in the TARANIS project
Source: [10, 14]

The system not only offers solutions for identified problems but also, based on meteorological forecasts, determines optimal timing for their resolution.

The use of Artificial Intelligence (AI) in the agricultural sector during a country's wartime conflict can present specific challenges and potential advantages (Table 3.).

Table 3

Specific Challenges and Potential Advantages of Using Artificial Intelligence

Challenges	Potential benefits
1.Ensuring the safety of agricultural workers in conflict	1.Automation and robotization of agricultural processes reduce the risk for people
2.Conservation and protection of agricultural infrastructure	2.The use of drones and video surveillance help detect and repair damage in a timely manner
3.Efficient management of resources such as water and fertilizer	3.Data analysis and machine learning help optimize resource utilization and maximize productivity
4.Detection and prevention of pests and plant diseases	4.Artificial intelligence allows you to detect problems in a timely manner and take measures to prevent them
5.Yield monitoring and detection of changes in crops	5.The use of modern technologies allows you to accurately measure yields and identify deviations
6.Analysis and forecasting of weather conditions	6.The use of meteorological data and forecasting help to plan agricultural actions depending on the weather
7.Food security in conditions of limited resources	7.Efficient use of artificial intelligence helps ensure sustainable food production in challenging environments

Source: compiled by the authors

The use of artificial intelligence (AI) in the agricultural sector during times of armed conflict brings significant advantages. AI enables the safety of agricultural workers, protection of agricultural infrastructure, and efficient resource management, including water and fertilizers. It also facilitates the detection and prevention of pests and plant diseases, monitors crop yields and changes in planting, analyzes and forecasts weather conditions, and ensures food security under resource constraints. The utilization of AI promotes the automation of agricultural processes, resource optimization, and sustainable food production even in challenging conflict situations.

The implementation of information technologies (IT) can greatly enhance the efficiency and resilience of the agro-industrial complex (AIC) during wartime. Here are a few recommendations for using IT for the successful functioning of the AIC in conflict conditions:

1. *Monitoring and forecasting systems.* Employ modern information systems to gather data on weather conditions, soil conditions, crop yields, and other factors influencing agricultural production. This aids in planning and decision-making with utmost accuracy.

2. *Process automation*. Introduce automated systems for monitoring and managing production, including irrigation, animal feeding, harvesting, and data processing. This reduces dependency on manual labor, boosts productivity, and lowers the risk of errors.

3. *Drone and satellite imagery.* Utilize drones and satellite images to monitor field conditions, detect pests, identify moisture deficiencies, and collect data with high resolution. This facilitates timely responses to issues and effective resource utilization.

4. *E-commerce and remote technologies.* Employ e-commerce and online platforms to ensure the sale of agricultural products, identifying new markets, securing deals, and interacting with clients even during wartime. Leveraging remote technologies like video conferencing supports communication with suppliers, partners, and stakeholders without physical presence.

5. *Data protection*. Ensure robust protection of information about agro-industrial activities. Utilize encryption, passwords, and other cybersecurity measures to prevent unauthorized access to critical data. Cybersecurity is particularly crucial during conflict when cyber threats can target critical infrastructure.

6. *Collaboration and data exchange*. Establish collaborations with other AIC entities, governmental bodies, and research institutions to exchange data and resources. This aids in planning, analysis, and decision-making based on the best available information.

7. *Training and qualification*. Invest in training and upskilling of AIC personnel in using information technologies, maximizing the potential of IT tools, and maintaining the necessary skills for their effective utilization.

The use of information technologies can significantly facilitate the management and support of the agro-industrial complex (AIC) during times of armed conflicts. It is important to develop and implement strategic plans and procedures for utilizing information technologies based on specific needs and conditions.

Conclusions and prospects for further research. In military conflicts, particularly in the context of the war in Ukraine, the use of information technologies holds significant importance for the successful functioning of the agricultural sector.
These technologies can ensure efficiency, resilience, and security within the

agricultural industry, contributing to food security and balanced industry development. A key aspect of employing information technologies lies in facilitating prompt data collection and analysis. This enables farmers and agribusinesses to access real-time information about market conditions, weather patterns, harmful factors, and other variables influencing production. Such capabilities facilitate swift responses to changes, allowing for adaptable production and marketing strategies.

The integration of remote technologies, such as video conferencing, sustains communication among farmers, suppliers, and consumers even amidst wartime conditions. This fosters discussions, action coordination, and knowledge exchange without the need for physical presence. Safeguarding information is a critical consideration when deploying information technologies during armed conflicts. The application of encryption, passwords, and other cybersecurity measures ensures reliable protection of vital data and prevents unauthorized access. Cyberattacks may target the theft of sensitive information, disruption of infrastructure operations, or even manipulation of production processes. Therefore, robust cybersecurity measures, including regular software updates, network threat monitoring, and employee cybersecurity training, are imperative. The utilization of sensors and "smart" systems also plays a crucial role in the agricultural sector during times of conflict. These technologies allow for the collection of data related to plant, animal, soil, weather conditions, and other parameters, enabling precise monitoring and management of production processes. For instance, automated irrigation systems can adapt watering schedules based on weather conditions, preserving water resources and promoting optimal plant growth. Furthermore, information technologies aid in production planning and management by considering diverse factors such as market trends, production capacities, consumer demands, and efficient resource utilization. All these aspects of employing information technologies contribute to increased productivity, efficiency, and resilience within the agricultural sector during armed conflicts. They provide necessary information, connectivity, and production control – elements particularly crucial in challenging wartime circumstances.

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АНОТАЦІЯ
ЗАСТОСУВАННЯ ПЕРЕДОВИХ ТЕХНОЛОГІЙ У АГРАРНОМУ СЕКТОРІ ДЛЯ ПІДВИЩЕННЯ ВАЛОВОГО ВИРОБНИЦТВА І ЕКСПОРТУ СІЛЬСЬКОГОСПОДАРСЬКОЇ ПРОДУКЦІЇ

Досліджено вплив інформаційних технологій на агропромисловий комплекс (АПК) під час воєнних конфліктів, зокрема на прикладі війни в Україні. Воєнні дії негативно впливають на сільськогосподарську діяльність, призводячи до знищення посівів, залізниць, заблокування транспорту та інфраструктури. Однак, інформаційні технології можуть грати важливу роль у забезпеченні продовольчої безпеки та підтримці АПК в умовах воєнного конфлікту.

Стаття аналізує використання інформаційних технологій, таких як дистанційне *зондування Землі, географічні інформаційні системи, дрони та сільськогосподарські датчики, які можуть забезпечити важливу інформацію про стан посівів, водних ресурсів та земельних ділянок. Такі технології допомагають фермерам у плануванні та прийнятті обґрунтованих рішень щодо оптимального використання ресурсів та забезпечення продовольчої безпеки навіть під час воєнного конфлікту.*

Додатково, стаття розглядає ефективність мобільних додатків, електронного документообігу та систем управління фермами у забезпеченні ефективного виробництва та організації сільськогосподарських процесів для збереження сталого функціонування АПК під час воєнного конфлікту. Ці технології дозволяють фермерам та керівникам агропідприємств здійснювати ефективний моніторинг та управління ресурсами, планувати роботу ферми та координувати дії персоналу навіть у умовах військових загроз.

Крім того, стаття аналізує етичні аспекти використання інформаційних технологій в АПК під час воєнних конфліктів. Це включає питання захисту конфіденційності даних фермерів, етичного використання даних з мобільних додатків та захисту приватності робітників. Досліджується також вплив цих технологій на суспільство та розвиток сільських територій під час конфліктів. Загалом, стаття пропонує комплексний погляд на використання інформаційних технологій у сільському господарстві під час воєнного конфлікту та наголошує на необхідності розробки та впровадження спеціалізованих рішень, які враховуватимуть унікальні виклики та потреби АПК у таких надзвичайних ситуаціях. Дослідження у цій галузі може сприяти забезпеченню сталого розвитку сільського господарства та підвищенню резистентності АПК до воєнних конфліктів та інших небезпек.

***Ключові слова**: інформаційні технології, штучний інтелект, сільське господарство, агропромисловий комплекс (АПК), воєнний конфлікт.*

Табл. 3. Рис. 6. Літ. 15.

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