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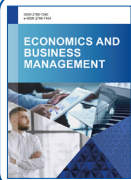
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Internal control system in organic production: Structure and functions

Abstract. This study was necessitated by the growing popularity of organic production in the world and in Ukraine, which requires ensuring strict quality and safety standards for products. The globalisation of markets, increased competition, and growing consumer demands require organic enterprises to develop and implement an effective internal control system (ICS). The purpose of this study was to investigate the structure of the internal control system at organic production enterprises, to identify the key functions of the internal control system and their role in ensuring product quality and compliance with established standards. General scientific and special research methods were employed, including the abstract and logical method, comparative analysis method, expert evaluation method, modelling and simulation method, and SWOT analysis. It was found that at agricultural enterprises that produce organic products, internal control underpins successful certification and entails a set of measures aimed at monitoring and assessing compliance with certification standards. The study analysed the key aspects of internal control, specifically, its principles, role in ensuring product quality, observance of organic production standards, and compliance with legislation. The key components of the internal control system that ensure the effective functioning of an organic production enterprise were identified as follows: manual, rules, ICS standard, personnel and functions, risk management systems, traceability of the production and supply chain and their interconnection. The study highlighted that the internal control system should be an extended and integrated component of the product quality management system, and not just a tool for compliance with standards. It was substantiated that the organisation of the internal control system requires constant attention and resources from the management and staff of the enterprise. It was proved that the introduction of an effective internal control system can positively

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affect the increase in consumer confidence in organic products, their competitiveness in the market and business stability. The practical value of the study lies in the fact that its findings can be used to manage organic production processes to ensure high quality products and meet consumer needs

Keywords: agriculture; organic products; consumers; ICS manual; ICS rules; risk management

INTRODUCTION

Global agriculture is steadily moving towards a new paradigm based on increased productivity through the transition to ecosystem-based development, one of the areas of which is the sustainable development of organic agriculture worldwide. There is a long-term trend towards its growth, as the area of organic land and the number of organic producers are increasing. Thus, the study was aimed at systematising theoretical and methodological approaches to the development and functioning of the internal control system in organic production.

The study of the problems of organic agricultural production in Ukraine has been reflected in the studies of many Ukrainian researchers. E. Mylovanov (2018) assessed the level of organic production in the context of environmentally sustainable development of rural areas of Ukraine. Using an integrated approach to the management of organic crop and livestock production, V.I. Artysh & N.V. Artysh (2022) considered the possibilities of increasing the competitiveness of crop production through the introduction of modern farming systems. A.I. Livinsky (2020) traced the problems of state regulation, certification of production, and sales of organic products in Ukraine. G. Sharyi *et al.* (2021) developed a structural and logical model of the management system at an organic farming enterprise, which included analysis and assessment of external and internal environmental factors. O.Yu. Havryk (2023) assessed the organisational and economic foundations of the functioning of the internal control system at agricultural enterprises.

According to A. Burkovska (2022), organic production is characterised by specific requirements for farming, which include minimising the use of chemicals, careful use of natural resources, and strict compliance with environmental regulations. Specifically, organic farming contributes to the conservation of biodiversity, reduction of greenhouse gas emissions and

carbon sequestration, energy efficiency, availability of clean water, nutrient cycling, food security, groundwater recharge, and landscape improvement. In this regard, T.O. Chaika *et al.* (2021) emphasised the need for producers to treat organic products and consumers who choose organic products in good faith.

A feature of Ukrainian organic exports is the dominance of agricultural raw materials. Most large organic producers and brands have been certified according to the standards of importing countries. Ukraine has a great potential for the development of the internal market for organic products: LLC "Organic Garden" (Lviv) – cultivation of organic blueberries under the brand "Stynava organic garden" (Stynava organic garden, n.d.), PJSC "EtnoProdukt" (Kyiv) – production of dairy products and meat (EATORGANIC, n.d.), LLC "Organic Milk" (Zhytomyr region) – dairy products (Organic Milk, n.d.). In addition, Khimex LTD (Kyiv region) produces cereals, groats, and flakes (Proorganica, n.d.) and PE GalexAgro (Zhytomyr region) produces cereals and honey (GalexAgro, n.d.). At the same time, small and medium-sized producers played a key role in the internal market of organic products: ECO BERRY farm (Ivano-Frankivsk region) and Darlisad LLC (Volyn region) – berries, Natsi LLC (Zakarpattia region) and Ukr Volnat LLC (Khmelnitskyi region) – walnuts, etc. (Ukrainian organic producers..., 2024).

T. Haiduchok & T. Ivashko (2024) concluded that to effectively manage resources and production processes, and to maintain the productivity of the industry, agricultural production requires constant internal monitoring, especially in the face of a deteriorating situation in the country. Despite a considerable number of publications, the issue under study is still relevant. The purpose of this study was to examine the internal control system in organic production, its structure, and functions. The primary tasks included the investigation of the system

structure and the identification of key ICS functions and their role in ensuring product quality and compliance with standards. In addition, the study analysed the relationship between various components of internal control to achieve efficient operation of the enterprise, highlighting the significance of internal control in the context of organic production and its impact on product quality and compliance with standards.

MATERIALS AND METHODS

To fulfil the purpose of the study, the following general scientific and special research methods were employed: analysis of literature and the regulatory framework - for an in-depth study of current standards and requirements for internal control in organic production; system analysis – to consider the structure of the internal control system, its components and functions. The abstract and logical method was applied to consider the basic principles of organic production (refusal to use synthetic chemicals, preservation of natural resources and biodiversity, ensuring the high quality of products and their safety for consumers, etc.), to understand their role in achieving environmental and social goals, and to identify common patterns inherent in all organic production. Comparative analysis was used to identify the strengths and weaknesses of internal control in organic production, identify opportunities for improvement, while expert opinions method was used to understand the views of experts and recommendations that can be used to develop more effective internal control systems. Modelling and simulation were used to determine the most effective structures and functions of internal control systems that can be implemented in practice, while SWOT analysis was applied to improve the internal control system by identifying its weaknesses and strengths.

The methodological framework of this study was based on legislative and regulatory acts (Law of Ukraine No. 2496-VIII, 2018; DSTU 7877:2015, 2015), official materials of the Cabinet of Ministers of Ukraine (Resolution of the Cabinet of Ministers of Ukraine No. 970, 2019). In addition, the study reviewed the international standards and regulations that Ukraine implements (Commission Regulation (EC) No. 889/2008, 2008) and the standards of the

International Federation of Organic Agricultural Movements IFOAM (IFOAM Standard, n.d.), which define global requirements for organic production, including the ICS, basic documentation of the group (land maps/master plans, list of all group members, description of the farm/field or production, contract signed by group members, analysis of efficiency/profitability); scientific and analytical articles of Ukrainian and foreign scientists, Internet resources. The study was based on a systematic approach to internal control in organic production as a complex phenomenon that plays a key role in ensuring that products conform to organic standards, as the internal control system covers not only control over production processes, but also acts as a strategic tool for managing product quality and safety, combining various control, monitoring, risk assessment, and reporting mechanisms.

RESULTS AND DISCUSSION

It was found that from the standpoint of state regulation of certification of production and sale of organic products, the necessary components of an effective system of state control include a clear legislative and regulatory framework for oversight (control). Clearly defined and delineated responsibilities of regulatory authorities, as well as concentration of supervision over products which, due to their inherent properties, pose an increased risk, as well as the availability of effective, fair, and incentive sanctions, effective information support, and competence of state inspectors.

For agricultural enterprises producing organic products, internal control underlies successful certification. It entails a set of measures aimed at monitoring and evaluating compliance with certification standards. It was found that the theoretical foundation of internal control is its basic principles and concepts. The concepts determine the development vector of the internal control theory, since they are the basis for setting goals. When developing the concept, the requirements for control are considered, and its functions help to correctly define the tasks and develop a reasonable programme for conducting an internal audit.

It was found that the internal control system is based on the following basic principles:

all farmers must have contractual obligations to grow organic crops, because the ICS organises training for farmers and conducts internal audits according to approved procedures. These inspections require the preparation of supplementary documentation, including contracts, descriptions of production units, inspection reports, harvest reports, and lists of farmers. In other words, the entire organic production process is subject to careful control and documentation. The findings of the study confirm the opinion of O. Bodnar (2021) that internal control records compliance with regulations on the efficiency and targeted use of funds to improve product quality, on the one hand, and on the other hand, ensures the relationship between the

object and subject of agricultural product quality control to assess the effectiveness of management decisions.

Building an internal control system involves determining its structure, the procedure for organising internal audits, and the persons responsible for developing internal control documents and making decisions. It was found that the internal control system has requirements for the availability of qualified personnel, an internal audit protocol, the procedure for admission to and exclusion from the group, a description of risk assessment procedures, etc. When switching to organic production, farmers sign an agreement confirming their obligations to follow the internal rules of organic production (Table 1).

Table 1. Sample of internal production rules

Area	Obligations
Training and meetings	Attendance of training events on organic production and internal control systems. Attendance of at least 3-5 meetings.
Documentation	Completion of all necessary documents (production log, receipts for the purchase of materials, etc.).
Employees performing work for hire	Provision of fair treatment and remuneration of employees, prevention of child labour exploitation.
Animals	Humane treatment of animals, avoidance of antibiotics and growth hormones, and prevention of manure contamination of water sources.
Diversity of ecosystems	Practise of mixing crops, protection of natural habitats where animals live.
Waste management	No environmentally sensitive materials (e.g., plastic products or batteries) should be disposed of in the fields.
Organic farming	No use of GMOs and synthetic chemicals for organic crops.
Organic soil insulation	Establishment of a buffer zone (requiring distance, hedges, etc.) to separate organic soil from pesticide-affected land. Prevention of irrigation of organic land with water from fields where pesticides or chemical fertilisers were applied.
Conservation of soil and water resources	Implementation of measures aimed at preventing soil erosion, improvement of infiltration, and preservation of soil moisture (including terracing, mulching, construction of dams, cultivation of cover crops, and contour planting).
Annual rotation of crops on the same field	Balanced use of the soil through crop rotation.
Seeds and planting material	Exclusive use of organic seeds and planting material. If unavailable, untreated seeds and planting material can be used.

Source: developed by the authors of this study based on the Legislative review of group certification of small and medium-sized organic farmers in Central Asia (2021)

It was found that the internal control system will be effective only if it contains the following components: manual, ICS standard, risk management system, functional responsibilities of personnel, traceability of the supply chain and production. The ICS manual consists of a description of the group and its land, products, climate, etc.; ICS rules and policies; staff structure and roles; description of procurement,

processing, and export processes; internal audit procedures and sanctioning policies; and a risk management system and traceability of the production chain. It was confirmed that the basis of the ICS includes such rules and procedures as internal social rules, procedures for attracting new members, sanctions policy, expulsion, and membership. The internal rules must be consistent with national legislation or

the Regulation of the European Parliament and of the Council of the EU on organic production and labelling of organic products (Regulation of the European Parliament and of the Council No. 2018/848, 2018) and approved by the general meeting with the consent of all group members after a risk assessment.

It was found that the group's management controls compliance with the requirements by the production units of each member through the policy of sanctions, expulsion, and entry into the group. The entry and expulsion policy is implemented based on internal rules and approved by the members of the organic operator group.

In case of major inconsistencies, such as the use of prohibited chemicals, the list of a new group of operators is updated. It is noted that sanctions are imposed based on the conclusion of an internal audit and enter into force by order of the group's ICS management committee or the head of the ICS. Non-compliant group members are subject to sanctions pursuant to the sanctions policy, including the possibility of deduction or expulsion from the group. Figure 1 presents the recommended structure of the internal control system. Table 2 provides examples of roles and responsibilities allocated to participants in the internal control system.

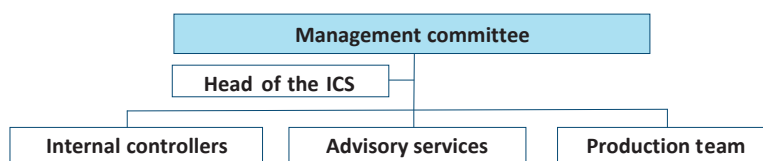


Figure 1. ICS organisation structure

Source: developed by the authors of this study based on the findings of the Legislative review of group certification of small and medium-sized organic farmers in Central Asia (2021)

Table 2. Distribution of functions and responsibilities between participants of the internal control system

ICS participants	Functions and responsibilities
Advisory service	<ul style="list-style-type: none"> ● approval of the list of non-compliances and sanctions applied; ● approval of the organic producer status based on the inspection reports; ● decision-making on exclusion of producers from the group due to their non-compliance with internal standards; ● consideration of applications from organic producers regarding decisions made by the head of the internal control service or internal controllers.
Head of the ICS	<ul style="list-style-type: none"> ● development, control, and revision of ICS procedures, forms, and other issues; ● training of specialists to spread knowledge about the ICS; ● control over internal audits (including re-inspection of individual farms); ● decision-making on sanctions for minor non-compliance.
Internal controllers	<ul style="list-style-type: none"> ● maintaining a register of producers (characteristics of the farm, field layout, size, etc.); ● control of farmers' record keeping and necessary documentation; ● collecting data and summarising information for further submission to the head of the internal control system; ● inspection of each farm (visiting the organic producer, familiarisation with record keeping, yield assessment); ● examination of depositories; ● control of marketing of organic products.

Source: developed by the authors of this study based on the Legislative review of group certification of small and medium-sized organic farmers in Central Asia (2021)

A detailed risk assessment is mandatory prior to any internal audit. The ICS should develop a way to avoid or minimise the potential impact of the identified risks. Without full

traceability of the value chain, the ICS cannot operate properly. Therefore, crop assessment is the first step in controlling the flow of produce. Controlling the flow of products starts at

the harvesting sites. At each level, all records of product inputs and outputs should be kept. It was argued that the internal control system performs the functions of document management, registration, and training of farmers, develop-

ment of reporting forms, direct verification, and evaluation of farmer compliance. Table 3 presents a list of the key procedures, identifying the persons responsible for each of them, as well as the reporting and documents to be submitted.

Table 3. Recommended procedures, responsible persons, reporting and documents

Procedures	Persons responsible	Reporting and documents
Signature of the agreement	Head of the ICS	Agreements with farmers and agreements on compliance with the group's internal rules.
Training farmers in organic methods	Head of the ICS	Pruning history logs, field maps, training plans, and training databases.
Technical advice and farm monitoring	Head of the ICS	Farmer registration form with mandatory data.
Farm inspection	Internal controllers	Inspection reports.
Database keeping	Head of the ICS	Farm database with product characteristics.
Approval of solutions for group farms	Advisory service	Inspection reports, approved list of organic producers.
Internal audits	Head of the ICS / Advisory service	Finalised audit reports and registration of all inspected farms.

Source: developed by the authors of this study based on the Legislative review of group certification of small and medium-sized organic farmers in Central Asia (2021)

An internal control system is crucial for farmers to follow organic standards. However, even the most sophisticated management system cannot provide complete control (Karabassov *et al.*, 2022). It was found that group members should be aware of their obligations, since if one

of the farmers violates organic standards, there is a risk of losing certification for all group members. However, in any group there are farmers who violate organic standards. Table 4 shows examples of sanctions depending on the level of violations.

Table 4. Examples of sanctions depending on the severity of the violation

Violation level	Sanctions	Decision level
Complex (A)	A1. If a farmer reports a violation of the established rules and standards, they are excluded from the group for 1 year. A2. If the internal controller finds that the farmer violated the established rules and standards, they are excluded from the group for a period of 2 years. A3. If an organic producer was found to use prohibited chemicals, the land plot is transferred for 2 years for conversion.	Advisory service
Medium (B)	B1. If the organic producer can remedy the violation in the reporting year, a notice is sent to the producer with a requirement to take the necessary measures, the implementation of which is checked by internal controllers. B2. If the organic producer can remedy the violation only in the following year, the producer is also notified and requested to take the necessary measures, and the implementation of the measures is monitored by an additional inspection by internal controllers.	Head of the ICS
Light (C)	C. The organic producer is notified and must take the necessary measures to correct the violation. The implementation of the measures is checked by internal controllers during the next official inspection. If the farmer commits a second violation, they are subject to sanction B1.	Internal controller

Source: developed by the authors of this study based on the Legislative review of group certification of small and medium-sized organic farmers in Central Asia (2021)

Thus, it was found that if a farmer did not conceal deliberate violations, they should have the option to leave the group, and if the violation

was detected by an internal controller, the farmer would be subject to clearly defined sanctions, depending on the severity of the violation (Table 5).

Table 5. Examples of sanctions selected depending on the severity of the violation

Type	Violation	Severity level	Notes
Access	Failure to provide an internal or external inspector with access to the facility.	A	If the manufacturer made a deliberate refusal, the A2 sanction will be applied. If not, an additional internal inspection will be ordered.
Fraud	More goods are sold than are actually produced on certified land plots.	A	A2 sanction
Weight gain	Weight gain of the product when sold (e.g., frozen products are sold with water).	A	A2 sanction
Elimination of inconsistencies	Failure to take measures to eliminate violations identified during the internal audit.	A/B	In case of a deliberate repetition of the violation, the sanctions should be increased.
Participation in meetings, training events, and gatherings	Failure to attend meetings, training events and gatherings without reasonable excuse.	C	C1 sanction
Documentation	Documents are stored improperly.	B/C	C1 sanction
Organic production	Insufficient measures were taken to separate organic and conventional production.	B	B1 sanction
Parallel production	Mixing of organic and conventional products.	A	A2 sanction
Biodiversity	Biodiversity is not sufficiently considered.	C	C1 sanction

Source: developed by the authors of this study based on the Legislative review of group certification of small and medium-sized organic farmers in Central Asia (2021)

Among the risks of organic production, the most common is the supply of non-organic products by group members alongside organic products, which are much more expensive. To avoid this risk, it is advisable to estimate the potential yield of crops for each farmer based on field area data and conduct a comparative analysis using the figures of previous years and analogous farms.

Once the key components of the internal control system are identified, training should be organised for staff with the involvement of experienced consultants. However, it was found that it is insufficient to set up an internal control function, hire staff and train them. It is

necessary to ensure that they perform their duties in good faith. To this end, the study proposed to introduce a system of cross-checks. Thus, it was found that farmers must follow the standards all year round, and therefore internal control should be carried out throughout the year. It was noted that to improve the ICS after the annual external audit, it is necessary to consider the comments of the auditors and make relevant adjustments to the internal control service instructions. To evaluate the strengths and weaknesses of this system, SWOT analysis tools were employed and the advantages and disadvantages of the internal control system at organic production enterprises were presented (Table 6).

Table 6. Advantages and disadvantages of the internal control system at organic production enterprises

Advantages	Disadvantages
<ol style="list-style-type: none"> 1. Compliance ensures that the products are truly organic. 2. Continuous monitoring of production processes allows identifying potential risks and deficiencies that may affect product quality. 3. Internal control ensures transparency of production processes, which is important for certification bodies and consumers. 4. Implementation and effective functioning of the internal control system enhances the company's reputation in the market, as it demonstrates a responsible attitude towards organic production standards and helps to attract new customers and partners. 5. The internal control system allows detecting violations before they lead to severe consequences, such as product recall or loss of certification. 	<ol style="list-style-type: none"> 1. Implementation of an internal control system requires major initial financial expenditures, regular staff training, technology upgrades, and audits. 2. The internal control system requires additional resources, such as qualified personnel, technological support, and specialised software for data collection and analysis. 3. The internal control system can lead to excessive bureaucratisation of processes, as it involves a large amount of documentation, reporting, and audits, decelerating the process and increasing the workload of staff. 4. Since internal control is performed by employees of the enterprise, sometimes a conflict of interest may arise, which can lead to a decrease in the objectivity of assessments and the omission of critical deficiencies in production.

Source: developed by the authors of this study

Despite its shortcomings, the ICS in organic production enterprises is a key mechanism for ensuring product compliance with standards and requirements, which helps enterprises ensure product quality and transparency of production processes.

The findings of the study are consistent with the conclusions of other researchers regarding the content of organic production and the organisation of the internal control system in organic production. Ukrainian researchers have mostly considered internal control as a management function, linking ICS with inspection. P.O. Kutsik *et al.* (2020) noted that ICS is an independent function that acts as a means of establishing feedback, so that the management staff of the enterprise clearly monitors the progress of the implementation of their decisions. Ya.I. Mulyk (2020) shared the same opinion when considering internal control as a significant basis for enterprise management, since it is the ICS that ensures verification of the effectiveness and implementation of management decisions, identification, and elimination of deviations in financial and economic activities and the accounting system, as well as control over the availability and use of material resources of the enterprise. It was found that this approach implies that the primary purpose of internal control is to identify deviations in the financial and economic activities of an

enterprise. However, the above conclusions limit internal control to verification and feedback only, which is unsuitable in the case of organic production.

R.O. Savchenko *et al.* (2019) also presented an interpretation of internal control as part of the overall enterprise management system. At the same time, the researchers emphasised that the accounting system should play an active role and a leading role in the information support of the control system. The present study confirmed the researchers' point that accounting is an integral component of internal control information support but noted that its role in the context of organic production is not the principal one. In organic production, the understanding of internal control is broader and includes not only the verification of accounting data, but also compliance with environmental standards, pollution risk assessment, monitoring of compliance with technological processes, and certification requirements. Specifically, this study argued that internal control involves a set of measures aimed at monitoring and assessing compliance with certification standards, while the internal control system is part of the quality assurance system (Hajiyeva *et al.*, 2024).

In the context of the study, the views of foreign researchers who link internal control in organic production with product certification were considered. An internal control system

(ICS) is a part of a documented quality assurance system that enables an external certification body to delegate periodic audits of individual group members to a designated body or unit within the certified operator (Internal Control Systems (ICS) for group certification, n.d.). In his study, P. Kumar (2023) interpreted the internal control system as a structured system that organic producers use to ensure that their products meet organic standards. It included a series of checks, documentation, and regular inspections to maintain the integrity of organic products. This approach helped to streamline the certification process, especially in organic production, where compliance with standards is critical to maintaining product status. The present study agreed with this point of view, as the ICS at the operator level plays a key role in maintaining ongoing monitoring and ensuring compliance with standards.

F. Meinshausen *et al.* (2019) reported that in low- and middle-income countries, about 80% of the world's organic producers are smallholders for whom individual certification would be unaffordable, and that group certification allows them to be recognised as organic. Groups of farmers certified by a third-party certification body implemented an internal control system. This aspect is crucial as it underlines the social and economic importance of the system for ensuring access to the organic market for small farmers. Accordingly, the ICS not only helped to maintain quality standards, but also served as a tool for social equity in organic production.

A.M. Varghese (2024) identified the purpose of an internal control system in organic production as monitoring and managing all aspects of production (from seed selection to harvesting), which ensures compliance with organic standards, reduces the risk of contamination or fraud, and maintains consumer confidence in organic products. This confirmed the idea that an internal control system should not only be a verification mechanism, but also a means of strategic risk management and compliance at every stage of the production process. The present study supported this approach, as it noted that for organic enterprises to function effectively, internal control should include all parts of the production cycle.

The findings of this study are in line with the statement of researchers that risk management in organic production is a component of the product quality assurance system. An effective system of risk management inherent in agricultural activities, according to E. Kalyuga *et al.* (2023), is a component of the ICS, which consists in identifying and defining measures to manage them. The use of COSO-ERM (Enterprise Risk Management) as an integrated approach to internal control allows for a systematic and comprehensive risk management strategy, which is essential for organic enterprises, where the quality of products is particularly demanding.

Risk assessment involves a thorough investigation of the factors that can lead to contamination of organic products in such a way that they lose their organic status. The availability and implementation of quality management systems is subject to inspection by certification bodies and authorities (Gulieva & Richter, 2018). It was noted that general approaches to risk management should be adapted to the specifics of organic production, since standard risk assessment methods do not consider all environmental and biological factors specific to organic production. Existing regulatory requirements are strict but not flexible enough to respond to the specific risks of organic production (seasonal fluctuations, biological pest control methods, etc.). A.Yu. Kril (2024) also considered the internal control system as a risk management tool, as an integral element of increasing the profitability of the enterprise, as a mechanism for strategic business development. This approach enriched the discussion on how effective risk management can not only ensure compliance with certification requirements, but also contribute positively to the economic performance of the enterprise.

CONCLUSIONS

The study found that the internal control system is a key element of organic production, as it ensures product quality and compliance with organic sector standards. Its structure covers a wide range of components, such as monitoring of production processes, documentation, staff training, and regular inspections, each of

which is essential for the proper functioning of organic production. In organic production, internal control should be considered not only as a mechanism for verification and monitoring, but also as a key component of the overall quality assurance system. It covers all stages of the production process, from the selection of raw materials to the finished product, which allows companies to ensure that their products meet organic standards.

The key components of the internal control system at organic production enterprises include the manual, rules, the ICS standard, personnel and functions, risk management systems, traceability of the production and supply chain and their interconnection. The implementation of an effective internal control system is a vital means of managing risks that could adversely affect the organic status of products, e.g., through contamination. The internal control system increases the level of transparency of production processes, which helps to strengthen consumer confidence in organic products and increase their market value. The conventional understanding of internal control as an

accounting tool does not fully meet the needs of organic production.

Effective implementation of the internal control system improves consumer confidence in organic products, increases their competitiveness in the market, and strengthens business sustainability in the face of market challenges. The study of the internal control system in organic production opens avenues for further improvement of quality management methods (digital technologies for process monitoring; innovative quality control methods (e.g., biosensors for soil and product monitoring; staff training and development) and standards in this sector. The findings may be useful for the organisation of internal control in organic production. Further research is necessary to improve the existing internal control standards and adapt them to the Ukrainian and international markets.

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CONFLICT OF INTEREST

None.

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Система внутрішнього контролю в органічному виробництві: структура та функції

Анотація. Дослідження було обумовлене зростаючою популярністю органічного виробництва у світі та в Україні, що вимагає забезпечення високих стандартів якості та безпеки продукції. Глобалізація ринків, зростання конкуренції, посилення вимог з боку споживачів, потребують від підприємств органічного сектору розробки та впровадження ефективної системи внутрішнього контролю (СВК). Мета статті полягала у дослідженні структури системи внутрішнього контролю на підприємствах виробництва органічної продукції, визначенні ключових функцій системи внутрішнього контролю і їх ролі у забезпеченні якості продукції та дотриманні встановлених стандартів. У роботі використовувались загальнонаукові та спеціальні методи дослідження, зокрема абстрактно-логічний метод, метод порівняльного аналізу, метод експертних оцінок, метод моделювання та симуляції, SWOT-аналіз. Було встановлено, що на сільськогосподарських підприємствах, які є виробниками органічної продукції, внутрішній контроль є основою успішної сертифікації і передбачає комплекс заходів, спрямованих на моніторинг та оцінку дотримання стандартів сертифікації. Проведений аналіз ключових аспектів внутрішнього контролю, зокрема, його принципів, ролі у забезпеченні якості продукції, дотриманні стандартів органічного виробництва та відповідності законодавству. Були визначені основні складові системи внутрішнього контролю, що забезпечують ефективне функціонування підприємства з виробництва органічної продукції: посібник, правила, стандарт СВК, персонал і функції, системи управління ризиками, простежуваність ланцюга виробництва і постачання та їх взаємозв'язок. Акцентовано увагу на тому, що система внутрішнього контролю повинна бути розширеною та інтегрованою складовою системи управління якістю продукції, а не лише інструментом для дотримання стандартів. Обґрунтовано, що організація системи внутрішнього контролю вимагає постійної уваги та ресурсів з боку керівництва та персоналу підприємства. Доведено, що впровадження ефективної системи внутрішнього контролю може позитивно впливати на підвищення рівня довіри споживачів до органічної продукції, її конкурентоспроможності на ринку та стабільності бізнесу. Практична цінність роботи полягає в тому, що результати дослідження можуть бути використані для управління органічними виробничими процесами з метою забезпечення високої якості продукції та задоволення потреб споживачів

Ключові слова: сільське господарство; органічна продукція; споживачі; посібник СВК; правила СВК; управління ризиками



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Review of the problems of the agro-industrial complex of Ukraine in connection with Russia's military aggression

Abstract. The war in Ukraine, unleashed by the aggressor state, has resulted in the loss of a significant portion of Ukrainian production, exports, raw materials, and food potential, creating substantial risks of prolonged economic instability, including threats to global food security. The purpose of this study was to analyse the impact of Russian military aggression on Ukraine's agricultural sector, particularly focusing on the economic challenges that have arisen in this field. Additionally, it examined the new circumstances and opportunities for the recovery and adaptation of agricultural producers in the post-war period. To achieve this aim, the following methods were employed: scientific generalisation, analysis and synthesis, forecasting, and scientific extrapolation. The literature review identified publications forming three thematic clusters. Analysis of the first cluster revealed that before the war, Ukraine, alongside Russia, ranked among the top ten global producers and exporters of agricultural products. In this context, foreign researchers expressed concerns regarding the potential threat to global food security. Analysis of the second cluster indicated that during the post-war years, Ukraine's export potential in the agricultural sector was reduced to a manageable level due to the Grain Agreement and the reorientation of agricultural product flows towards land routes on Ukraine's western border. The third cluster highlighted that the stability of Ukraine's agricultural sector will be severely disrupted if the war persists for an extended period. The practical significance of this article lies in its comprehensive analysis of the economic challenges faced by Ukraine's agricultural sector, offering a foundation for devising effective strategies to support and restore this crucial sector during the war and in the post-war era.

Keywords: agribusiness; industry; food market; global food security; food market; Google Scholar; ScienceDirect

INTRODUCTION

The ongoing war between Ukraine and Russia is the largest conflict in Europe since World War II and has numerous geopolitical, economic, infrastructural, environmental, and medical

consequences. Agriculture, as a leading industry in Ukraine, plays a pivotal role in generating export revenue and ensuring food security for other countries. P.M. Makarenko *et al.* (2023), based

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on pre-war data from the State Statistics Service of Ukraine, noted that the competitiveness of Ukraine's agri-food sector constitutes approximately 19% of the country's gross domestic product (GDP) and is the main budget-generating sector of the national economy, contributing about 12% of the country's budget and a third of its commodity structure. The report highlighted that many authors evaluate Ukraine's contribution to the global food system and its security in comparison to Russia's role. Russian and Ukrainian agricultural production significantly exceeds domestic consumption and represents a disproportionately large share of the global market.

As reported by H. Hussein & M. Knol (2023), data from the United States Department of Agriculture (USDA) indicate that in 2020, Russia and Ukraine accounted for approximately 6% of the global maize harvest, 12% of the wheat harvest, and 13% of the barley production. By 2020, Russia and Ukraine collectively accounted for over 70% of global exports of sunflower oil and sunflower meal, approximately 30% of barley exports, 27% of wheat exports, and 17% of rapeseed exports. Given their critical role in the global food supply, the conflict between these two countries has significantly disrupted and posed a substantial threat to the stability of the world's food system. N. Demianenko *et al.* (2023) observed that the global challenges of 2019-2023 have further impacted the global food system. Supply chains were particularly disrupted by Russian aggression, affecting not only African nations but also the broader international community. The authors propose that the creation of startups could serve as a driving force for global Industry 4.0, facilitating the development of a 4.0 supply chain. The human resources of Ukrainian agricultural workers have also been severely impacted. According to the Food and Agriculture Organisation (FAO, 2024), more than 150,000 farmers have been affected by the war and forced to migrate.

In the context of Russian aggression, Ukrainian agricultural producers face a severe shortage of financial resources due to rising production costs. For example, O. Dorosh *et al.* (2024) noted that capital investments in the agricultural sector in 2023 decreased by 26.1% compared to the previous year, amounting to 51.4 billion UAH. The authors propose addressing this issue

through budget financing, effective taxation, a fair pricing policy, preferential loans (particularly for organic farming), grant support, and new subsidy schemes. O. Shubravskaya *et al.* (2024) highlighted the weakness of state support for Ukrainian agriculture, drawing comparisons with Polish farmers. According to their findings, Ukrainian producers receive 35 times less support per hectare than their Polish counterparts. Only 1.4% of income from agricultural production factors received by Ukrainian producers is allocated to subsidies. The authors argued that opportunities for agricultural development within the framework of European integration primarily involve diversifying production and export structures, improving agricultural product processing, accelerating the adoption of resource-efficient innovative production technologies, establishing transit flows, increasing exports to global markets, and expanding the share of Ukrainian agricultural products that comply with the European Union's environmental and climate requirements.

According to estimates by the Kyiv School of Economics, 5.56 billion USD will be required to rebuild Ukraine's agricultural sector over the next 10 years (Neyter *et al.*, 2024). The war between Russia and Ukraine has resulted in the loss of a significant portion of Ukraine's production, export, and food potential, creating a substantial risk of long-term economic instability. At the same time, as noted by T. Bodnarchuk (2022), new challenges have fostered favourable conditions and opportunities for restructuring the national economy towards the development of the high-tech sector and enhancing the informational capabilities of traditional industries. As there were no comprehensive reviews of publications addressing the Ukrainian agro-industrial complex in the context of Russian military aggression, this article aimed to compile such a review, highlighting key clusters of publications. This overview of issues related to the Ukrainian agro-industrial complex, based on a literature search using Google Scholar and ScienceDirect, utilises the keywords "Agro-industrial complex" and "Ukraine" in Google Scholar within the time frame 2018-2024. In ScienceDirect, the term "Agriculture of Ukraine" was used for searches limited to 2023-2024. The tool primarily

searches articles in Elsevier publications, including those indexed in the Scopus database.

In the literature search conducted between 2018 and 2021, two clusters of publications were identified: the production and export potential of Ukraine's agro-industrial complex prior to the onset of Russia's full-scale aggression, and the impact of Russia's full-scale aggression on the production and export potential of Ukraine's agro-industrial complex, including the development and implementation of measures to enhance the resilience of agriculture and facilitate Ukraine's post-war recovery. Methods of scientific generalisation were employed to systematise data on the impact of the war on the agricultural sector. This approach allowed for the identification of the main trends, problems, and challenges facing agriculture, as well as the formation of recommendations for the recovery and development of the sector under crisis conditions. Methods of analysis and synthesis were applied for a detailed examination of the economic impact of the war on the agricultural sector. These methods facilitated the identification of key factors affecting agricultural productivity and sustainability, as well as the collection and integration of diverse data to develop comprehensive conclusions and recommendations. Methods of scientific extrapolation and forecasting were utilised to evaluate future trends in the agricultural sector under wartime conditions. These methods enabled the determination of potential scenarios regarding the conflict's impact on production, markets, and foreign economic relations, alongside the formulation of recommendations for the long-term stabilisation of agriculture.

PRODUCTION AND EXPORT POTENTIAL OF UKRAINE'S AGRO-INDUSTRIAL COMPLEX BEFORE THE ONSET OF RUSSIA'S FULL-SCALE AGGRESSION

Ukraine ranks among the world's leading producers and exporters of agricultural goods, primarily due to its favourable climatic and natural conditions for agricultural development. The country's agroindustrial complex comprises specialised enterprises and organisations engaged in the production, processing, transportation, marketing, and proper storage of

agricultural products (Zaharin, 2018; Ivaskevich, 2018). Under normal conditions, Ukraine is a global leader in agricultural production, with an annual output of 90-100 million tonnes of food (Izhevsky, 2018; Naumenko, 2019). Before the war, the agri-food sector was the cornerstone of the national economy, serving as the primary budget-generating industry. It contributed approximately 19% to the gross domestic product (GDP), 12% to the state budget, and accounted for one-third of the country's export commodity structure.

According to additional data, Ukraine's agricultural sector contributes approximately 10% to the GDP and generates 40% of the country's foreign exchange earnings from exports. Agriculture occupies over 41.4 million hectares of Ukrainian land, with about 31 million hectares under private ownership and 10.4 million hectares owned by the state and communes (Dun-ska & Bilykh, 2022; Gromov, 2022). With 33% of its land area dedicated to agriculture, a favourable climate, and proximity to major markets, Ukraine has established itself as a critical agricultural export hub with substantial processing capacities. The country leads globally in sunflower oil exports and ranks among the top grain exporters. Between 2019 and 2021, Ukraine accounted for approximately 10% of global wheat exports, 15% of maize exports, 15% of barley exports, and nearly 50% of sunflower oil exports. Furthermore, the agri-food sector is a cornerstone of Ukraine's economy, contributing significantly to employment and GDP. According to the USDA, Ukraine ranked as the second-largest grain exporter globally after the United States in 2019-2020. In 2021-2022, Ukraine's share in global exports included approximately 40% of sunflower oil, 27% of sunflower seeds, 5% of barley, 3% of wheat, 3% of rapeseed, and 2% of maize (Ukraine: FAIRS export..., 2023).

J. Wandel (2023) provided additional insights into the combined export potential of Ukraine and Russia. In 2020, these two countries collectively accounted for 69% of global sunflower meal exports, 65% of sunflower oil, 28% of wheat, and 15% of maize. Ukraine, in particular, dominated global markets for sunflower meal and oil, while Russia emerged as the largest wheat exporter, surpassing the European Union, the United

States, Canada, and Ukraine. The war in Ukraine has significantly disrupted the operations of these two major agricultural producers, posing a severe threat to the food security of low-income nations. This crisis has heightened international concerns about global food security. Despite considerable political, economic, and social transformations since Ukraine's independence and its transition to a market economy, land policies and systems of intensive agricultural production have remained largely unchanged.

Meanwhile, global challenges related to food supply and environmental safety persist as critical issues requiring urgent solutions (Degtyareva, 2018). For instance, UN experts estimate that the combined effects of the war and the COVID-19 pandemic will drive the number of food-insecure individuals to its highest level in 15 years (Lucii & Korniyuchuk, 2022). As one of the world's top ten exporters of agricultural products, Ukraine's sustainable and innovative development in agriculture holds the potential to enhance its agroecological profile. This development could create the foundation for increased competitiveness in both domestic and international markets, thereby contributing to the resolution of global food security challenges (Radchenko & Pidvalna, 2020; Dumanska, 2023). In summary, addressing global food security challenges requires urgent solutions, and Ukraine's focus on sustainable agricultural development could play a key role in enhancing its competitiveness while contributing to global food supply stability.

THE IMPACT OF RUSSIA'S LARGE-SCALE AGGRESSION ON THE PRODUCTION AND EXPORT POTENTIAL OF THE UKRAINIAN AGRICULTURAL SECTOR

In 2022, the ongoing military conflict in Ukraine plunged the agricultural sector into its most challenging period since the country gained independence. Land occupation and the war led to the loss of 3.5 million hectares of arable land, alongside shortages of labour, machinery, fuel, and capital, as well as the disruption of supply chains. This situation brought unprecedented hardship to farmers. The conflict, which escalated significantly since February 2022, resulted in reduced crop yields and the physical destruction of agricultural activities. A decline in

grain acreage (by over 30%) and the blockade of export routes from Ukrainian ports contributed to a global food crisis (Chub, 2022). The blockade of these ports has caused food shortages and rising prices in several developing countries, leading to significant social upheaval (Chala & Barbul, 2020; Babenko, 2021).

The Russian military occupation has effectively incapacitated Ukrainian ports, through which approximately 90% of Ukraine's agricultural exports were previously transported. According to the Ministry of Agrarian Policy of Ukraine, while ports once handled around 150,000 tonnes of grain, only about 20,000 tonnes are now being moved by rail. Despite these challenges, the Ministry reported that the 2022 harvest was expected to be over 67 million tonnes. Following the signing of the Grain Agreement, August 2022 saw 68 ships depart from Ukrainian ports, transporting 1.72 million tonnes of agricultural products to 18 countries. The total volume of agricultural shipments across various logistics routes in August amounted to roughly 5 million tonnes. Throughout 2022, Ukraine's agricultural and food exports totalled 50.9 million tonnes, with a total value of 21.1 billion USD (Lucii & Korniyuchuk, 2022). Ukrainian agricultural and food products accounted for 53% of total exports in 2022 and remained the most exported product in the entire sector.

Improved logistics, access to the railway, and proximity to the western borders ensured efficient production for Ukrainian companies in 2022 (Demianenko *et al.*, 2023). The share of the European Union in Ukraine's total exports increased from 41% in 2021 to 62% in 2022. Turkey, China, and India were other important trading partners. The reorientation of Ukraine's trade towards the EU was facilitated by the signing of the Black Sea Grain Initiative and the creation of the "Solidarity Road" by the European Commission to strengthen Ukraine's ties with the EU (Hubeni *et al.*, 2024). As these data show, Ukraine continues to contribute to global food security, supported by robust financing of the agricultural sector. Thus, according to the Ministry of Agriculture, by the beginning of 2023, Ukrainian farmers had received more than 34.5 billion UAH in support for the development of their farms (Rudevska *et al.*, 2024).

Despite the ongoing military conflict, 99% of the companies affiliated with the European Business Association (2023) expressed their intention to continue operating in the Ukrainian market in 2023. Furthermore, 63% of these companies planned to invest in Ukraine, even amid wartime conditions. On the other hand, only 17% of new investors considered it worthwhile to expand their business in Ukraine. Despite the direct and indirect losses amounting to 41.1 billion USD that Ukraine's agro-industrial complex has incurred since the onset of the full-scale war, the prospects for its development remain positive. According to O. Zgurska *et al.* (2022), the total losses incurred by the sector as of 2022 amounted to 41.1 billion USD. The study also concluded that the local agricultural sector demonstrated resilience in the face of the global COVID-19 crisis and Russian aggression. Having analysed studies of Ukrainian researchers on the impact of Russian aggression on the Ukrainian agricultural sector, attention must now turn to the work of foreign researchers on this topic.

A systematic review of foreign literature on the impact of the Russian-Ukrainian war on Ukraine's agricultural sector on the ScienceDirect (n.d.) platform revealed a large collection of studies that estimate the damage caused to Ukrainian agriculture based on aerial photographs. For example, continuous analyses of free Sentinel-2 satellite data using machine learning classified approximately 500,000 hectares of arable land in 10 regions of Ukraine as damaged during 22 two-week periods in 2022, with the most significant impact observed from March to September. Additionally, aerial monitoring estimated that grain production losses in six eastern regions in 2022 were up to 31.5% compared to the average yield in 2016-2020 and up to 6.76% compared to national grain production (He *et al.*, 2023). Another group of studies identified through ScienceDirect focuses on the analysis of time series related to exchange rates (including agricultural futures and spot prices) and indices such as volatility indices (Deininger *et al.*, 2023). These studies also examine the correlation between geopolitical shocks and time series risk indices (Neik *et al.*, 2023; Polat *et al.*, 2023; Aizenman *et al.*, 2024). These papers utilise advanced time series analysis techniques, including the

Copula-CoVaR approach, the Student's perturbed ARMA-GARCH model, structural vector autoregression (SVAR), and time-varying vector autoregression (TVP-VAR). Both groups of studies rely on methodological tools designed to analyse the impact of the Russian-Ukrainian war on Ukraine's agricultural sector.

A Google Scholar search of foreign articles on the impact of the war between Russia and Ukraine on Ukrainian agriculture yielded several studies summarised below. For instance, A. Rose *et al.* (2023) described how military conflict directly affects grain exports and its economic impact on the world market. Since the export of grain from Ukraine plays an important role in ensuring food security, this situation has the potential to trigger a global food crisis. These authors provide a detailed analysis of the impact of the decline in grain exports on macroeconomic indicators in various regions. Similarly, Kh. Ay & A. Söylemez (2023) emphasised the importance of the Black Sea Grain Initiative for Ukraine's grain exports and assessed Turkey's policy in negotiating this agreement. M. Qin *et al.* (2023) highlighted that in the face of severe climate change and the war between Russia and Ukraine, the stabilisation of global supply chains is crucial for the sustainable development of the world. S. Ahn *et al.* (2022) argued that Russia's attack on grains and oilseeds has negatively affected world trade, leading to significant price fluctuations and threatening global food security. Their study provides an assessment of the actual impact of the Russian invasion of Ukraine on international trade in grains and oilseeds. The authors found that imports of grain and oilseeds to Ukraine between February and July 2022 were 78.2% lower than expected. The war resulted in a shift in trade flows, primarily benefiting North American and European countries. The study concluded that while the Russian-Ukrainian conflict had a significant effect on the trade of the directly involved countries, its impact on global grain and oilseed markets in terms of trade volumes was more limited.

The USDA has released its 2024-2025 World Wheat Market Forecast, which predicts increased supply, consumption, and trade, as well as a slight decline in stocks. Supply is forecast to increase by 3.5 million tonnes to 1,060.6 million

tonnes, mainly due to increased production in Ukraine, Kazakhstan, and Australia, which will offset cuts in the EU and the US. The growth of production in Ukraine will be supported by data from the National Bureau of Statistics on a larger-than-expected harvest area. World consumption is anticipated to increase by 4.1 million tonnes to a record 804 million tonnes, mainly due to increased use of feed and waste in the EU, Kazakhstan, and Ukraine. World trade is expected to increase by 2.0 million tonnes

to 214.9 million tonnes, primarily due to increased exports from Australia and Ukraine. In 2024-2025, based on the World Agricultural Supply and Demand Estimates (WASDE, 2024), world-ending stocks are projected to decline by 0.6 million tonnes to 256.6 million tonnes, the lowest level since 2015-2016. Selected actual data on the supply and use of wheat in Ukraine and Russia in recent years, based on the Forecasts of World Agricultural Demand and Supply, are shown in Table 1.

Table 1. Wheat supply and use (million metric tonnes) for Ukraine and Russia

Countries	Beginning stocks	Production	Import	Export	Ending stocks
2022-2023					
Ukraine	6.27	21.50	0.06	17.20	2.90
Russia	12.09	92.00	0.30	49.00	14.39
2023-2024 Est.					
Ukraine	2.90	23.00	0.07	18.40	0.77
Russia	14.39	91.50	0.30	55.50	10.19

Source: compiled by the author based on data WASDE (2024)

From this table, it is evident that in terms of the main indicators of wheat production and export, Russia is three to four times more advanced than Ukraine. However, according to forecast estimates for 2023-2024, these indicators for Ukraine are expected to improve, although they remain significantly lower due to the ongoing conflict. The WASDE report does not provide comparable data for Ukraine and Russia regarding the supply and use of oilseeds. Nonetheless, the USDA data presented in the WASDE report, using wheat production and export as an example, also highlight the stability of the Ukrainian agricultural sector.

Given the critical role that Russia and Ukraine play in the global food supply, the outbreak of the Russian-Ukrainian conflict has undeniably had a significant impact on and posed a substantial risk to, the global food system (Rawtani *et al.*, 2022; Neik *et al.*, 2023; Zhou *et al.*, 2024). However, it is apparent that if the war persists for an extended period, this stability will likely be disrupted. Therefore, it is crucial to develop and implement measures aimed at strengthening this stability and restoring the potential of Ukraine's agricultural sector in the aftermath of the conflict.

DEVELOPMENT AND IMPLEMENTATION OF MEASURES TO STRENGTHEN AGRICULTURAL STABILITY AND POST-WAR RECOVERY IN UKRAINE

Targeted measures at both the national and international levels are crucial for ensuring the stability of Ukraine's agricultural sector and enabling effective post-war recovery. The conflict has caused extensive damage to the country's agricultural infrastructure, disrupted supply chains, and restricted export opportunities. Given the strategic significance of agriculture for Ukraine's food security and the global food system, the development and implementation of strategies to restore and strengthen this sector are of paramount importance. For example, O. Dorosh *et al.* (2024) highlighted the urgent need to restore infrastructure and support agricultural producers through government programmes. Destroyed warehouses, access roads, and agricultural facilities must be restored to ensure smooth production processes and expand product storage capabilities. This restoration process should include financial assistance from national and international partners to facilitate a rapid return to stability in the agricultural sector. O. Shubravska *et al.* (2024)

noted the need for market diversification to reduce reliance on traditional suppliers. Similarly, V. Rudevskaya *et al.* (2023) argued that it is important to provide social support to rural agricultural communities to prevent migration and restore social stability in war-affected areas. The state programme should provide financial and social support to stabilise the economic situation in the agrarian sector.

T. Bodnarchuk (2022) emphasised that farmers need to adapt their production methods by introducing new technologies, such as unmanned aerial vehicles for crop monitoring, and innovative farming methods that optimise costs and increase yields even under wartime conditions. The blockade of ports and disruption of supply chains, exacerbated by rising prices for fuel, fertilisers, and other essential resources, have significantly reduced the competitiveness of Ukrainian agricultural products on the international market and made production more challenging. In addition, the war has significantly complicated the export of agricultural products, which previously constituted a significant part of the national income. The blockade of Black Sea ports and instability on land routes have forced Ukrainian agricultural enterprises to explore alternative markets, particularly in neighbouring countries such as Poland and Romania. O. Shumilova *et al.* (2023) examined the consequences of the war in terms of new environmental challenges for the agricultural sector. Specifically, military operations, bombings, explosions, and the use of military equipment have caused severe soil contamination, affecting both soil and water quality.

Residues of heavy metals, fuel, lubricants, and chemicals in the soil necessitate immediate remediation measures to prevent long-term deterioration of crop yields and product quality. Additionally, the war has destroyed natural ecosystems and biodiversity; many natural areas, such as forests, reservoirs, and pastures, have been severely damaged. This has led to a decrease in biodiversity and the loss of natural habitats for flora and fauna, increasing the risk of ecological imbalance, affecting agroecosystems, and reducing the resilience of the agricultural sector to natural disasters. Third, increased soil erosion caused by disruption to the

topsoil has heightened the risk of water and wind erosion. Y. Hubeni *et al.* (2024) observed that the war threatens food security not only in Ukraine but globally, as Ukraine has traditionally been a major grain exporter. The ongoing port blockades have exacerbated global food shortages, increasing food prices and reducing availability, particularly in Africa and Asia.

Another key issue is the need to adopt environmentally friendly technologies. Post-war agricultural recovery necessitates the use of “green” technologies that minimise environmental impact, conserve biodiversity, and enhance ecological sustainability. Adopting these technologies will also help Ukraine improve its international reputation as a producer of ecologically clean products. The successful implementation of these measures requires collaboration among national, institutional, and international partners who can provide financial and technical resources for restructuring. A comprehensive strategy that incorporates modern farming techniques and technological innovations will not only ensure long-term food security and economic stability for the country but also establish the foundation for the sustainable development of Ukraine’s agricultural sector.

CONCLUSIONS

According to the study, an analysis of 42 sources from 2018 to 2024 identified three main clusters of publications. The first cluster focused on the characterisation of the production and export potential of Ukraine’s agro-industrial complex before the onset of full-scale Russian aggression, highlighting its strengths and development prospects. The second cluster contained two subclusters: the first described methodological tools for quantitative assessment of the impact of the Russian-Ukrainian war on the agricultural sector, while the second focused on searching foreign articles on the ScienceDirect platform from 2023 to 2024. The review concludes that if the war continues for an extended period, the stability of the Ukrainian agricultural sector, as defined above, is likely to be disrupted. Therefore, it is imperative to develop and implement measures to enhance this stability and restore the potential of the Ukrainian agricultural sector in the post-conflict period.

The analysis of the third cluster indicated that, in the event of a prolonged military conflict, the consequences will necessitate the development of new conceptual approaches to address these challenges. Such measures should include state and financial support, soft loans, and grants to help farmers resume production and acquire necessary resources. The state should also stimulate the adoption of environmentally friendly and energy-efficient technologies, which will minimise environmental impact and increase the sustainability of the agricultural

sector. This issue requires a dedicated review of the literature and further research to identify the most effective measures. Moreover, fostering public-private partnerships could further strengthen the sector's recovery and long-term resilience.

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CONFLICT OF INTEREST

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<https://doi.org/0000-0002-8591-8202>**Огляд проблем агропромислового комплексу України у зв'язку з військовою агресією Росії**

Анотація. Війна в Україні, розв'язана державою-агресором, призвела до втрати значної частини виробничого, експортного, сировинного та продовольчого потенціалу України, створивши великий ризик довгострокової економічної нестабільності, у тому числі ризик глобальної продовольчої безпеки. Метою статті був аналіз впливу військової агресії росії на агропромисловий комплекс України, зокрема вивчення економічних проблем, які виникають у цьому секторі. Огляд також передбачав розгляд можливостей відновлення та адаптації агровиробників у нових умовах та в повоєнний час. Для досягнення мети були використані такі методи: метод наукового узагальнення; аналізу та синтезу; прогнозування та наукової екстраполяції. У літературному пошуку було відібрано публікації, які утворили три кластери. Аналіз напрацювань першого кластера показав, що до війни Україна, як і росія, входила до десятки світових виробників та експортерів сільськогосподарської продукції. У зв'язку з цим зарубіжні дослідники були стурбовані підривом глобальної продовольчої безпеки. Аналіз другого кластера публікацій показав, що в перші роки війни аграрний експортний потенціал України скоротився на некритичну суму через Зернову угоду та переорієнтацію потоків сільськогосподарської продукції на сухопутні коридори на західних кордонах України. Аналіз третього кластера вказав на те, що стабільність українського аграрного сектору буде порушена, якщо війна триватиме досить довго. Практична цінність статті полягає в наданні глибокого аналізу економічних викликів, з якими стикається та буде стикатись у майбутньому агропромисловий комплекс України, що може слугувати основою для розробки ефективних стратегій підтримки та відновлення цього важливого сектора в умовах війни та в повоєнний час

Ключові слова: аграрний бізнес; галузь; глобальна продовольча безпека; продовольчий ринок; Google Scholar; ScienceDirect



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Ecological and economic justification of the efficiency of solid waste management in territorial communities

Abstract. The problem of effective municipal solid waste (MSW) management is becoming increasingly relevant due to the growing negative impact on the environment and the need to integrate environmental approaches into the strategies of local communities. The purpose of the study was to determine the impact of the waste management system on the preservation of ecosystems and to study the economic indicators associated with the implementation of sorting and recycling systems. The paper examined the effectiveness of solid waste management in the territorial communities of Lviv Oblast: Zabolottsivska, Davydivska, Trostianetska, and in particular, the environmental and economic effects of waste sorting and recycling. The study was based on an analysis of statistical data on the amount of solid waste per person, the average number of people in households, waste morphology, and indicators of the environmental and economic impact of recycling. The study found that by introducing effective sorting systems in communities, it is possible to reduce waste by 25-30%, reduce the negative impact on ecosystems and reduce greenhouse gas emissions. The analysis showed that educational programmes for the population and access to the necessary recycling technologies play a significant role in the effectiveness of these processes. The study also identified the need to increase the level of citizen engagement in sorting and recycling programmes, in particular through improved infrastructure and more accessible waste collection points. The conclusions highlight that improving the efficiency of solid waste management requires a comprehensive approach that includes technological innovations, public education programmes and scientific evidence for environmental strategies. The results may be useful for the development of waste management strategies in other regions with similar conditions

Keywords: environment; pollution; greenhouse gas; disposal; recycling

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INTRODUCTION

The problem of efficient municipal solid waste management (MSW) is one of the most pressing for modern communities. Given the rapid growth of urban agglomerations, intensive consumption of resources and increased production, waste management is becoming a significant challenge for the environment and the economy. The growing amount of solid waste, environmental pollution and lack of efficient waste treatment systems require new approaches to waste management, focusing on sustainability and minimizing the impact on ecosystems. In this regard, the issues of environmental and economic efficiency of solid waste management measures are becoming extremely important for the sustainable development of local communities.

Several attempts have been made in Ukraine to improve the situation with waste management, including: The National Waste Management Strategy until 2030 (Order of the..., 2017). Its goal is to harmonize Ukrainian legislation with European standards. The main tasks include building infrastructure for waste treatment and recycling, reducing the volume of waste disposal, and introducing extended producer responsibility. The Law of Ukraine 2320-IX "On Waste Management" (2022) creates the legal framework for the transition to European principles in this area, including the introduction of an electronic waste management system, the development of sectoral legislation (e.g., for packaging and electronic equipment waste), and attracting investment in the construction of recycling plants. However, despite certain successes, the problem remains unresolved. In particular, the issues of proper waste sorting, recycling, disposal and waste reduction remain relevant for many communities.

H.I. Evchuk (2024) studied the organisational aspects of waste management in the agricultural sector of Ukraine. The researcher focused on ecological and economic approaches that minimize the environmental impact of agricultural waste, in particular through the integration of recycling methods into the production processes of agricultural enterprises. This study emphasises the importance of adapting agricultural practices to the requirements of

sustainable development in order to achieve efficient and safe waste management.

The specifics of solid waste management on the example of the Dashivska community, analysing the existing mechanisms of waste collection, sorting and recycling, were studied by A. Lempa & G. Mudrak (2022). The study aimed to increase the environmental and economic efficiency of solid waste management by offering a model that can be applied by other communities to improve the environment.

It is important to study the impact of environmental factors, in particular air pollution, on the development of cardiovascular disease. T. Münzel *et al.* (2022) analysed how toxic elements released into the atmosphere as a result of human activity (e.g., emissions from industry and transport) contribute to the development of cardiovascular disease. In particular, they discussed the mechanisms by which air pollution can lead to inflammation in the body, increased blood pressure, and the development of atherosclerosis. The role of fine particles and other toxic substances that have a negative impact on blood vessels and the heart was also highlighted.

The study by J.A. Domínguez-Gómez (2024) focused on the gender aspects of natural resource management, especially in the mining sector. The author examined how the social and environmental impacts of natural resource extraction are unevenly distributed among local communities, with a focus on the role of women in these processes. Mining leads to significant environmental and social problems, such as deterioration of water and soil quality, as well as reduced health.

An analysis of the toxicological risks of emerging pollutants associated with tyre rubber was conducted by Y. Jiang *et al.* (2024). The study identifies how these compounds, in particular 6PPD, affect aquatic ecosystems and threaten biodiversity. M.I. Aldagheiri & I.S. Alrebdi (2024) investigated the morphological characteristics of MSW in Buraydah, Saudi Arabia, and identified factors that affect its composition. The study focused on the analysis of the types, quantity and seasonal changes of MSW, as well as the socio-economic factors

that determine the consumption behaviour of residents. N. Anene *et al.* (2024) analysed gold and mercury losses in artisanal mines in Nigeria and their impact on the environment and economy. The paper emphasises the low efficiency of mining technologies, which leads to the loss of resources and environmental damage. Also, C.A. Nieto-Cañarte *et al.* (2024) conducted a comparative assessment of microbial activity during the decomposition of the organic component of MSW in the city of Guayaquil, Ecuador. The study focused on determining the effectiveness of different environmental conditions in stimulating organic decomposition, which is important for the development of local waste management strategies.

The link between environmental factors and cancer risk was examined by R.O. Ajayi & T.T. Ogunjobi (2024). They focused on how pollutants can contribute to the onset of cancer. The paper analyses in detail the role of carcinogens present in the environment and their impact on health. The authors highlighted the need to reduce exposure to harmful chemicals, especially for vulnerable groups, and offered recommendations to minimize risk, such as strengthening environmental controls and implementing measures to reduce exposure to pollutants in everyday life.

Research on waste management and environmental risks covered a variety of aspects: from environmental and economic approaches to reducing the impact of waste in the agricultural sector to analysing the social and environmental consequences of human activities. Many papers investigated the health impacts of air pollution, including cardiovascular disease, and the role of toxic substances in aquatic ecosystems.

Gaps that require further study include the underestimation of environmental aspects in planning waste management strategies, the lack of effective financing mechanisms, and the insufficient level of adaptation of local governments to new challenges.

Thus, the purpose of this study was to examine the environmental and economic efficiency of solid waste management on the example of territorial communities in Lviv Oblast (Ukraine).

MATERIALS AND METHODS

The study covered households in Lviv Oblast, focusing on rural communities: Zabolottsivska, Davydivska, Trostianetska, where the level of MSW sorting was relatively low. The analysis was carried out between June and September 2024 based on statistical data characterizing the volume of MSW generation, morphological composition and dynamics (Table 1).

Table 1. Volumes of solid waste generation in rural communities of Lviv Oblast (June-September 2024)

Community	Number of households	Average number of people in a household	MSW per person per year (kg)	Total volume of MSW (t)
Zabolottsivska	1560	4	460	2865.6
Davydivska	5053	4	500	10106
Trostianetska	6171	4	480	11873.28

Source: compiled by the authors based on the State Statistics Service of Ukraine (2024)

Official data from the State Statistics Service of Ukraine (2024) and environmental departments of the region were used to collect information on the volume of MSW and its morphological composition. The main sample included data on the number of households in rural areas of Lviv Oblast, the average number of people in a household, and the amount of MSW per person per year.

The study used methods of collecting, analysing and synthesizing statistical data, as well

as environmental modelling to assess the effectiveness of the introduction of solid waste sorting and recycling. To assess the environmental impact of waste, the study analysed its morphological composition (organic, plastic, paper, glass and metal waste). Indicators of soil, air, and water pollution resulting from the accumulation and decomposition of MSW were used (Yaksmanytska, 2020). To assess the economic benefits of solid waste sorting, the study examined the average waste generation rates

for households with 3-4 people, and analysed the sorting of the main categories of waste and their further processing. The study determined how much solid waste could be recycled, what proportion could be composted, and how reducing the total weight of solid waste could reduce waste disposal costs. To assess ecosystem services, analysis methods were used to estimate the negative impact of improper MSW management on biodiversity and soil productivity. An analysis was carried out to show what environmental benefits can be realised through waste sorting and recycling.

The study also used the main regulatory documents governing solid waste management in Ukraine, which is important for understanding the legal context and relevant requirements. In particular, the State Classifier of Ukraine. Waste classifier DK 005-96 (1996) was used to define the categories of solid waste, their characteristics, and classification. This document helped to systematize waste, which allowed for the correct calculation of the proportion of waste suitable for sorting, recycling or composting. Law of Ukraine 2320-IX "On Waste Management" (2022) – served as the basis for determining the principles of solid waste management in communities. In particular, the study assessed the compliance of existing waste management practices with legal requirements, in particular, to reduce the amount of solid waste going to landfills. Order of the Ministry of Housing and Communal Services of

Ukraine No. 39 "On Approval of Methodological Recommendations for Determining the Morphological Composition of Solid Waste" (2010) – methodological recommendations for determining the morphological composition of solid waste were applied. This allowed for standardizing the approach to waste composition analysis in selected communities and ensuring the correctness of the data used for modelling. The National Waste Management Strategy for Ukraine until 2030 was used to align the study results with national waste management priorities (Order of the..., 2017). In particular, the analysis and recommendations developed were based on the principles of sustainable development laid down in the strategy. These regulatory documents served as the basis for identifying effective methods of solid waste management within the study and developing recommendations for its reduction and recycling.

RESULTS AND DISCUSSION

Impact of MSW on the environment

According to research, Lviv landfills have a significant impact on ecosystems and public health (Yaksmanytska, 2020). Landfills contribute to soil contamination with heavy metals (mercury, cadmium, lead) and microplastics, which poses risks to plants, soil organisms and groundwater pollution (Table 2). Studies have also shown that the decomposition of organic waste releases methane and CO₂, which cause greenhouse effects and degrade air quality.

Table 2. Assessment of environmental impact in communities of Lviv region and possibilities for its reduction

Community	Indicator	Level of influence	Major pollutants	Impact reduction opportunities
Zabolottsiivska	Soil pollution	High	Agrochemicals, MSW landfills	Introduction of organic farming, waste sorting.
	Water pollution	Medium	Landfill leaks, agriculture	Water purification, pollution monitoring, creation of buffer zones.
	Greenhouse gas emissions	Low	Transport, local heating systems	Energy efficiency of buildings, transition to renewable energy sources.
Davydivska	Soil pollution	High	Agricultural fertilizers, MSW	Crop rotation, use of biofertilizers, recycling of organic waste.
	Water pollution	High	Domestic wastewater, chemicals from fields	Construction of local treatment facilities, control of agrochemicals.
	Greenhouse gas emissions	Medium	Transport, private boiler houses	Development of public transport, insulation of buildings.
Trostianetska	Soil pollution	Medium	Improper waste management	Public education, creation of landfills for safe waste storage.

Table 2, Continued

Community	Indicator	Level of influence	Major pollutants	Impact reduction opportunities
Trostianetska	Water pollution	Medium	Industrial wastewater, insufficient water treatment	Modernisation of treatment facilities, protection of rivers from industrial discharges.
	Greenhouse gas emissions	Low	Heating in private households	Installation of solar panels, subsidies for energy-efficient technologies.

Source: compiled by the authors based on the State Statistics Service of Ukraine (2024)

Table 2 provides an analysis of the main environmental challenges in three communities in Lviv Oblast: Zabolottsivska, Davydivska and Trostianetska. Three main indicators are considered: soil and water pollution and greenhouse gas emissions. For each of the indicators, the level of impact, the main sources of pollution and possible measures to minimize their negative impact are identified. The table shows potential strategies to reduce the environmental burden, taking into account the specifics of each community.

Soil contamination with heavy metals, microplastics, and other toxic substances is one of the key environmental issues in the communities of Lviv Oblast. In the Zabolottsivska and Davydivska communities, the level of exposure has been identified as high due to a significant number of unauthorised landfills and the use of agrochemicals. Heavy metals such as lead, cadmium, and arsenic remain in the soil for a long time, leading to soil degradation and loss of fertility. In the Trostianetska community, the level of impact is medium, but the problem of improper waste management remains a concern. To mitigate the impact in these communities, it is proposed to introduce organic farming, sort solid waste and build landfills for safe waste storage.

Water pollution in the communities is a serious problem, especially in the Davydivska community, where the level of impact is identified as high. In the vicinity of landfills, water is contaminated with toxic compounds such as nitrates, phosphates and heavy metals. This poses risks to ecosystems and water supply systems. Eutrophication of water bodies due to organic pollutants is becoming increasingly common. In the Zabolottsivska community, the level of impact is medium, due to leaks from landfills and pollution from agriculture. The Trostianetska community also faces problems, but their scale

is smaller. Possible solutions include the construction of local sewage treatment plants, control of agrochemicals, and the creation of buffer zones around water bodies.

Landfills in communities also cause air pollution. In the Davydivska community, where the level of greenhouse gas emissions is defined as average, the main sources are local boiler houses and transport. In the Zabolottsivska community, emissions are low, but pollution from transport and domestic heating systems remains a challenge. Methane and hydrogen sulphide released during the decomposition of organic matter pose health risks to the population. Suggested measures include building insulation, the introduction of renewable energy sources and the development of public transport.

Soil, water, and air pollution in the communities of Lviv Oblast is a serious environmental problem. The analysis points to the need to implement comprehensive measures such as building modern landfills, improving waste recycling infrastructure and promoting separate waste collection. Such actions will not only improve the environmental situation, but also the quality of life of the residents.

Morphological composition of MSW in households

The morphological composition of MSW is an important indicator for determining the possibilities of its recycling and disposal. MSW typically consists of organic, plastic, metal, glass and paper materials. Understanding the structure of MSW allows for the development of effective waste sorting and recycling strategies, helping to reduce the negative impact on the environment.

In Lviv region, for example, studies of the morphology of MSW show that the bulk of waste is made up of organic materials and plastic that can be recycled or composted. According to

the data obtained, a significant part of MSW consists of organic waste that can be used to make compost, which reduces the load on landfills (Table 3).

Table 3. Morphological composition of MSW in an average household in Lviv region

Community	Waste category	Share (%)	Recyclable or compostable
Zabolottsiivska	Organic waste	46	Recycling (composting)
	Plastic	24	Recycling
	Paper	11	Recycling
	Metal	8	Recycling
	Glass	4	Recycling
	Other waste (wood, textiles, etc.)	7	Partial recycling or landfilling
Davdivivska	Organic waste	45	Recycling (composting)
	Plastic	25	Recycling
	Paper	12	Recycling
	Metal	7	Recycling
	Glass	5	Recycling
	Other waste (wood, textiles, etc.)	6	Partial recycling or landfilling
Trostanetska	Organic waste	48	Recycling (composting)
	Plastic	22	Recycling
	Paper	10	Recycling
	Metal	9	Recycling
	Glass	7	Recycling
	Other waste (wood, textiles, etc.)	4	Partial recycling or landfilling

Source: compiled by the authors based on the State Statistics Service of Ukraine (2024)

Waste sorting at the household level is a key step in ensuring effective recycling. An analysis of the potential volume of waste that can be transferred for recycling or composting has made it possible to understand how much waste can

be saved from landfill disposal and how to use secondary resources efficiently (Table 4). In Lviv Oblast, an important step is to encourage the population to sort waste, which can significantly reduce the amount of waste that goes to landfill.

Table 4. The potential volume of waste for sorting in an average household (3-4 people) in Lviv region

Community	Waste category	Potential volume (kg/month)	Recyclable or compostable
Zabolottsiivska	Organic waste	55	Composting
	Plastic	7	Recycling
	Paper	5	Recycling
	Metal	8	Recycling
	Glass	4	Recycling
	Other waste (wood, textiles)	22	Partial processing
Davdivivska	Organic waste	61	Composting
	Plastic	5	Recycling
	Paper	8	Recycling
	Metal	7	Recycling
	Glass	3	Recycling
	Other waste (wood, textiles)	18	Partial processing
Trostanetska	Organic waste	48	Composting
	Plastic	8	Recycling
	Paper	4	Recycling
	Metal	10	Recycling
	Glass	6	Recycling
	Other waste (wood, textiles)	31	Partial processing

Source: compiled by the authors based on the State Statistics Service of Ukraine (2024)

The morphological composition of MSW showed a significant proportion of organic waste that can be used for composting, as well as plastic, metal, and paper materials that can be recycled. Sorting and recycling capabilities can significantly reduce the burden on landfills, in particular through the efficient sorting of organic waste for composting and plastic, metal and paper waste for recycling. The introduction of progressive sorting and composting practices in households is an important step towards improving the environmental situation in the Lviv region and reducing the negative impact of solid waste on the environment.

Strategies to reduce the impact of MSW on ecosystems

To minimise the environmental impact of solid waste, it is recommended to introduce sorting and composting of organic waste, which will significantly reduce the amount of waste that goes to landfills. Composting reduces methane emissions, and recycling reduces the need for natural resource extraction, which contributes to biodiversity conservation and improves the environmental state of the region.

Composting is an important strategy to reduce the amount of organic waste going to landfill. Composting processes organic waste such as food scraps and plant materials into useful soil material, which significantly reduces the need to dispose of this waste through landfilling. This has important environmental benefits, including reducing emissions of methane, a potent greenhouse gas that is produced when organic materials decompose in landfills. Methane is 25 times more potent than CO₂, so composting helps to reduce its emissions into the

atmosphere, which contributes to the fight against global warming. Plastic recycling is another key strategy that has a significant impact on reducing the need for oil and other natural resources. The production of new plastic products usually requires significant energy and raw material inputs, as plastic is mostly made from petroleum. Recycling plastic significantly reduces the need for new raw materials and energy costs. In addition, plastic recycling helps to conserve resources and reduce the negative impact on ecosystems, as plastic waste can pollute the environment, including seas and oceans, if not disposed of properly. Recycling plastics helps to reduce their entry into the natural environment, particularly aquatic ecosystems, which is important for biodiversity conservation.

Paper recycling has a direct impact on forest conservation, as it reduces the need to cut down trees to produce new paper. Forests are important ecosystems that support biodiversity, regulate the climate and provide soil stability. Preserving forests is essential for maintaining ecological balance, so reducing deforestation through the use of recycled paper helps to conserve natural resources. This strategy also has other environmental benefits, such as helping to reduce air pollution and carbon dioxide emissions, as less energy is required to produce new paper products compared to virgin paper from wood.

Economic benefits for households

Separate waste collection and recycling allow households to reduce the cost of MSW collection and generate additional income from recycling. Based on average prices in Lviv oblast, the potential income of a household from recycling can be up to UAH 500 per year (Table 5).

Table 5. Economic benefits of MSW recycling

Community	Share of MSW to be sorted	Reduction in MSW mass (t)	Savings on MSW removal (thousand UAH)
Zabolottsiivska	65%	150	225
Davydivska	70%	200	300
Trostanetska	60%	180	270

Source: compiled by the authors based on the State Statistics Service of Ukraine (2024) and M.O. Barinov *et al.* (2021)

Sorting MSW brings direct benefits to households through savings in waste removal costs. The less waste that has to be taken to

landfills or incinerators, the lower the transport costs (Table 6). For example, separating organic and plastic waste can reduce the frequency

of collection, as it reduces the amount of total waste that needs to be transported. Additionally, many municipalities offer financial incentives for households that sort their waste, which further reduces disposal costs. Households can also earn additional income from recycling

certain types of waste. There are programmes in Ukraine that allow households to receive money for recycling plastic bottles, paper and glass. The average income depends on the type of material and its value on the recycling market (Table 7).

Table 6. Savings from reducing the number of solid waste removals

Waste type	Waste reduction (kg/month)	Potential savings on exports
Organic waste	10-15 kg	20-30%
Plastic	5-10 kg	15-20%
Glass	2-5 kg	5-10%

Source: compiled by the authors

Table 7. Environmental benefits of MSW sorting

Parameter	Soil contamination (%)	Water pollution (mg/l)	Greenhouse gas emissions (t)	Mass of MSW (t/year)
Zabolottsivska (without sorting)	30	50	100	1000
Zabolottsivska (with sorting)	15	25	60	650
Impact reduction (%)	50	50	40	35
Davydivska (without sorting)	35	55	120	1200
Davydivska (with sorting)	14	22	72	720
Impact reduction (%)	60	60	40	40
Trostianetska (without sorting)	28	48	90	900
Trostianetska (with sorting)	11	20	54	585
Impact reduction (%)	61	58	40	35

Source: compiled by the authors based on the State Statistics Service of Ukraine (2024)

The sorting and recycling of solid waste has a major environmental impact, in particular by reducing the amount of waste that goes to landfill. This contributes to the preservation of ecosystems, as it reduces the need for new land for landfills and reduces soil and water pollution. Recycling materials such as plastic and paper also helps to reduce the need to extract natural resources and reduces greenhouse gas emissions from the production of new materials. Waste sorting therefore has a direct impact on improving the environment, in particular by reducing air, soil, and water pollution.

Adaptation of communities to modern environmental challenges through environmentally sound waste management

Information and education campaigns are an important element in promoting environmentally conscious behaviour in communities. These campaigns aim to raise awareness of the benefits of waste sorting and recycling, as well as the

importance of conserving resources and reducing the burden on the environment. Since waste sorting is a relatively new practice for many citizens, such campaigns help to change people's attitudes towards waste and inspire them to actively participate in recycling programmes.

One effective approach is to hold information meetings and workshops to educate citizens about sorting techniques, the benefits of composting organic waste, and the economic and environmental benefits of recycling. Additionally, local authorities are actively using digital platforms to disseminate information, including through social media, websites and mobile apps that provide step-by-step instructions and tips on how to sort properly.

Evidence on the effectiveness of such campaigns shows that active information and the availability of resources for the population significantly increase the level of participation in sorting (Barinov *et al.*, 2021). For example, in communities where campaigns with active citizen

engagement through media and social media have been conducted, sorting rates can increase by 15-20% in a few months. This demonstrates that educational activities have a real impact on changing environmental behaviour and contribute to the development of more sustainable environmental practices among the population.

Improper solid waste management can have a significant impact on biodiversity and disrupt ecosystem services provided by nature. Pollution, in particular through unauthorised landfills, contaminates the habitats of many species of flora and fauna, which can lead to their extinction. In particular, soil contamination with heavy metals, chemicals, and microplastics has a negative impact on plants, which are an important part of food chains. Toxic substances can poison organisms, reducing their ability to reproduce and survive.

In Ukraine, according to environmental studies by V. Chupa & L. Zhovtulia (2023) in areas where large volumes of waste are accumulated, there is a decrease in the number of certain animal species, such as small mammals and insects. This is due to soil and water pollution, which reduces the availability of food for these organisms. Many species of flora, especially wild plants that grow in areas with high levels of pollution, can be destroyed or severely damaged. Improper waste management has a significant impact on ecosystems, including soil, water and air resources, which are critical to sustaining natural processes and human activities. The accumulation of organic and inorganic waste, such as plastic, metal and chemicals, can lead to soil contamination. This negatively affects their productivity, reducing fertility and the ability of the soil to support vegetation. Waste released into the soil can contain toxic substances that, in turn, degrade the quality of soil ecosystems by changing their chemical composition and structure.

MSW often contains chemicals that can penetrate groundwater or contaminate surface water. This poses a risk to human and animal health, as contaminated water can be used for drinking or irrigation. Water pollution is most common in areas where waste is not collected properly, as well as at landfills, where stormwater and other leaks can enter surrounding water bodies. The combustion of solid waste,

especially plastic and synthetic materials, releases harmful gases such as dioxins, furans and carbon dioxide into the atmosphere. This causes air pollution, which has a negative impact on human health and climate, increasing greenhouse gas levels. As a result of improper MSW management, ecosystems undergo significant changes, which affects the efficiency of natural services such as water purification, food supply, climate regulation and protection against soil erosion (Pisarenko *et al.*, 2019).

The issue of solid waste management and its environmental and economic aspects has become a subject of study for many scientists. Numerous studies cover different approaches to waste sorting, recycling, and the implementation of circular economy strategies. Scientists have investigated how the effectiveness of these methods can affect the environment and the economy, and analysed regional and international strategies aimed at reducing the negative effects of waste. In this context, it is important to consider studies that cover both global and local initiatives that promote sustainable development in the field of waste management.

The issue of environmental and economic feasibility of energy efficiency projects in the residential sector was considered in the work of E.O. Skrypka & S.O. Nikolayev (2019). Although the study focused on energy efficiency, the principles of environmental and economic feasibility of projects could be applied to solid waste management. The study focused on economic and technical parameters, while the current work focused more on environmental aspects.

Also, A.V. Dudnyk (2019) analysed the environmental and economic management in urban systems. The study was aimed at a global perspective, while in this case, the emphasis was on solid waste management in territorial communities, in particular, in the Lviv region. Similarly to A.V. Dudnyk's work, the study considered the impact of anthropogenic factors on ecosystems, but the specificity of management approaches was different.

Modern innovative methods of waste disposal were analysed in the work by I. Vlasenko & V. Postova (2020), which contained recommendations for reducing the negative impact on the environment through innovative technologies.

In comparison, the study emphasised the role of local waste management strategies in the context of environmental efficiency within the Lviv region. It is worth noting that a feasibility study of waste recycling in Ukraine was carried out by I. Kolodiichuk (2021). This study had a common goal with the analysis of the cost-effectiveness of waste recycling, but the work paid more attention to technical aspects. The study focused on the environmental aspects and outcomes for ecosystems.

Scientists R. Mohee *et al.* (2015) examined the state of waste management on small islands, which had differences from the topic under study, which concerned the management of solid waste in communities in Lviv Oblast. However, the basic principles of waste management and recycling technologies were similar, particularly in terms of reducing the impact on ecosystems. The European Green Deal and the rationale for the rational configuration of a bioenergy production system from organic waste were considered by I. Tryhuba *et al.* (2024). The study focused on the bioenergy aspects of organic waste use, while this study focuses on the processing of household waste within specific territorial communities.

The role of the informal sector in waste management and poverty alleviation in Nigerian communities was discussed in the work by B. Garba & E. Haruna (2024). This study was similar in its approach to analysing the impact of waste management on social factors, but the study focused more on the environmental aspect and cost-effectiveness of waste management at the local level in Ukraine. The fiscal and budgetary aspects of waste management regulation in Ukraine were studied by V. Holian *et al.* (2024). It is worth noting that the focus was on legislative and financial mechanisms, but the study also included approaches to analysing the economic effects of waste management. This is comparable to the methods used in the study on the cost-effectiveness of waste management in Ukraine. Scientists B. Gegić *et al.* (2024) modelled the processes of integrated production of bioethanol and biogas from municipal organic waste. The main focus on the energy use of organic waste in comparison to this study was concentrated on other aspects

of waste management, especially community-based recycling.

In the study by Y. Rahmani *et al.* (2024), the authors examined the sustainability of urban waste management through data mining for municipal waste composting in Tehran. This study used data mining methods to assess performance, which is similar to the approaches to assessing the environmental performance of waste management in Ukraine, but it did not focus on the specific economic impacts of waste management on local communities. The compliance of Spanish local administrations with European waste management regulations was assessed in the paper by I. Sobrino-García (2024). This study focused on legislative compliance with standards, while the study conducted in Ukraine focused on the economic and environmental aspects of waste management within local communities.

An important cultural aspect of municipal waste management in Indonesia and its relationship to climate change was studied by P. Resolute (2024). This study raised the issue of socio-cultural factors in waste management, which is an interesting addition to the study that focuses on the economic and environmental efficiency of waste management in Ukraine, without considering cultural aspects. Scientists J.P. Doussoulin & Q. Kakar (2024) considered the concept of sustainable waste management and circular economy. The application of this concept is similar to the ideas underlying the study of waste management efficiency in Ukraine, which examined waste recycling with economic benefits, focusing on the environmental effect.

The role of socio-economic development in urban waste management through machine learning was explored in the work by C.A. Velis *et al.* (2023). The analysis of performance indicators is similar to the use of statistical methods in the study on waste management assessment in Ukraine, but the emphasis in this study was on the use of the latest technologies for data collection and analysis. The transition to a circular economy in Ukraine in the context of European integration, as well as waste management strategies during the war and the recovery period, were discussed in the paper by V. Shvedun *et al.* (2023). The study emphasised the importance

of sustainable waste management in crises, which is an important addition to the study of environmental sustainability during the post-war recovery period at the local level in Ukraine.

A. Fehr *et al.* (2020) analysed the socio-economic dynamics of sustainable waste management in transition economies. This study has similarities with the study in Ukraine, as both aim to assess socio-economic factors in the context of transition economies, in particular in the context of changing waste management models. The researchers D. Ofori & A. Opoku Mensah (2022) investigated a sustainable approach to e-waste management among households, considering the concept of a circular economy in a developing economy. At the same time, the study on household waste management in Ukraine also focused on the circular economy. It is worth noting that the analysis of the socio-economic efficiency of changes in the structure of the waste management system within the circular economy was carried out by T. Tomić & D.R. Schneider (2020). This study is similar to the analysis of the effectiveness of solid waste management in Ukraine, in particular, the study of the effect of changes that occur under the influence of new approaches to recycling and disposal.

The financial and economic evaluation of investments in water treatment plants was carried out in the study by J. Četković *et al.* (2022). Although this work focused on water treatment, similar approaches to investment in waste management infrastructure can be applied in the context of studies aimed at developing a solid waste management system in Ukraine. M. Osińska (2024) assessed the efficiency factors of municipal solid waste management in EU countries. The study has similarities with the assessment of efficiency in Ukraine, in particular in terms of comparing indicators in different European countries and taking into account different approaches to waste management, which can be useful for analysing efficiency at the national level.

In summary, the analysis has shown that effective solid waste management requires a comprehensive approach that includes the introduction of innovative methods of waste sorting and recycling, as well as the development of

a circular economy. Various scientific studies point out the importance of integrating environmental and economic strategies to achieve sustainable development in this area. Despite significant progress, there are still challenges that require further study and improvement of waste management approaches.

CONCLUSIONS

The study conducted to assess the effectiveness of solid waste management in Lviv Oblast identified several important aspects that are important for improving the environmental situation and increasing the efficiency of local waste management systems. The study confirmed that solid waste management is a key environmental issue that requires a systematic approach, particularly in the context of Lviv Oblast. The average amount of waste per household is about 1800-2000 kg per year, which requires measures to reduce its volume and environmental impact. It has been found that the level of waste sorting has a direct impact on the amount of materials recycled and the reduction of waste going to landfill. By implementing waste sorting practices, the need for waste transport and treatment is reduced. This reduces economic costs and negative impacts on ecosystems.

The study confirmed that effective waste sorting and recycling can significantly improve the environmental situation in local communities. It was found that waste sorting reduces the amount of materials going to landfills and reduces the risk of soil and water pollution. The use of recycling technologies, such as composting organic waste, can significantly reduce the amount of waste that takes up space in landfills and creates organic fertilizers for agriculture. Economically, optimised solid waste management reduces the cost of waste transportation and treatment, and generates revenue from the sale of recyclable materials, which helps to develop local businesses. In addition, waste reduction and recycling of plastic, glass and metal help to reduce energy costs and greenhouse gas emissions, which has a positive effect on climate change.

Based on the results obtained, the following steps can be recommended to improve the efficiency of solid waste management: expanding

waste sorting infrastructure and establishing additional recycling collection points. Implementing training and education programmes among the population to raise awareness of the importance of waste sorting and recycling. Creating conditions to support local waste recycling businesses, which will help increase recycling volumes and economic benefits for communities.

To improve the results obtained in the future, it is crucial to conduct additional research on the effectiveness of different waste treatment methods. In particular, research should focus on the impact of composting technologies and biogas plants, and determine their economic

feasibility for local communities. In addition, it is worth exploring the possibilities of using innovative technologies in the sorting and recycling of plastic waste, which is one of the biggest environmental challenges. Overall, the study confirms the importance of an integrated approach to local solid waste management and highlights the need for further research to improve existing systems and technologies.

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CONFLICT OF INTEREST

None.

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Еколого-економічне обґрунтування ефективності поведінки з твердими побутовими відходами територіальних громад

Анотація. Проблема ефективного поведінки з твердими побутовими відходами (ТПВ) стає дедалі актуальнішою через посилення негативного впливу на довкілля та необхідність інтеграції екологічних підходів у стратегії місцевих громад. Метою дослідження було визначити вплив системи управління відходами на збереження екосистем і вивчити економічні показники, пов'язані з впровадженням систем сортування та переробки. У роботі розглянуто ефективність управління ТПВ у територіальних громадах Львівської області: Заболотцівська, Давидівська, Тростянецька, зокрема оцінено екологічні та економічні ефекти від сортування та переробки відходів. Дослідження ґрунтувалося на аналізі статистичних даних щодо кількості ТПВ на одну людину, середньої чисельності осіб у домогосподарствах, морфології відходів, а також показників екологічного та економічного ефекту від застосування переробки. В результаті дослідження було встановлено, що за рахунок впровадження ефективних систем сортування в громадах можна знизити обсяг відходів на 25-30 %, зменшити негативний вплив на екосистеми і знизити викиди парникових газів. Аналіз показав, що значну роль у ефективності цих процесів відіграють освітні програми для населення, а також доступ до необхідних технологій переробки. У дослідженні також виявлено необхідність у підвищенні рівня залученості громадян до програм сортування та рециклінгу, зокрема через поліпшення інфраструктури та організацію більш доступних пунктів збору відходів. У висновках підкреслено, що покращення ефективності управління ТПВ потребує комплексного підходу, який включає технологічні інновації, навчальні програми для населення і наукове обґрунтування екологічних стратегій. Результати можуть бути корисними для розвитку стратегій управління відходами в інших регіонах з подібними умовами

Ключові слова: довкілля; забруднення; парниковий газ; утилізація; переробка



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The impact of flexible work schedules on employee productivity in the modern business environment

Abstract. This study aimed to examine the impact of flexible work schedules on employee performance and to explore their benefits and challenges. The research methodology included a review of practical cases of flexible work schedule implementation in countries such as Sweden, Finland, the USA, Japan, the Netherlands, India, the UK, Germany, and Israel. A survey was also conducted among 500 employees across various industries in Ukraine. The results of the study indicate that flexible work schedules contribute to increased productivity, improved work-life balance, and reduced stress levels among employees. In particular, in creative and highly skilled professions, flexibility allows employees to adapt the work process to their individual rhythm, thereby increasing both the quality and speed of task completion. However, in sectors where synchronisation of work is essential, such as manufacturing or the civil service, the implementation of flexible work schedules faces certain limitations. A study of the Ukrainian context revealed that the war has been a catalyst for the introduction of flexible employment models, particularly in response to challenges related to air raids, power outages, and the forced relocation of workers. The survey found that 75% of respondents reported increased productivity as a result of flexible schedules, while the main challenges identified were time management and ensuring effective team interaction. It was concluded that the successful implementation of flexible schedules depends on the level of digitalisation, organisational culture, and adaptation to the specific nature of the tasks. It is recommended to invest in digital technology infrastructure, ensure equal access to flexible forms of employment, and regularly monitor their effectiveness. The results obtained may be useful for developing national policies and management decisions aimed at adapting organisations to modern challenges

Keywords: autonomy; innovation; organisational culture; adaptability; risks and barriers

INTRODUCTION

The relevance of this topic stems from global trends that are shaping the modern world of work. The COVID-19 pandemic has significantly accelerated the adoption of remote work and

transformed perceptions of how and where work should be carried out. Increasingly, companies are viewing flexible work schedules not merely as a privilege, but as a necessary tool for

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maintaining high productivity levels, adapting to change, and attracting talented personnel. At the same time, the implementation of flexible schedules requires careful planning, as it may present new challenges related to team coordination, task performance monitoring, and preserving corporate culture.

In a business environment characterised by dynamism, technological innovation, and rising demands for competitiveness, effective management of working time is becoming a critical factor in employee productivity. Flexible work schedules, which allow employees to independently manage their working hours or choose the location from which they perform their duties, are gaining popularity across various sectors. This practice is increasingly recognised as a key approach to enhancing employee satisfaction, reducing stress levels, and optimising company resources.

The topic focuses on the challenge of balancing employee flexibility with organisational control and efficient resource management. Modern businesses aim to determine the impact of flexible schedules on productivity, assess their influence on employee motivation, and identify potential risks and limitations associated with their implementation. Approaches to studying flexible work schedules are grounded in the concepts of organisational behaviour, human resource management, and labour economics. One of the key principles underpinning these approaches is the idea that autonomy and freedom of choice can have a positive impact on employee productivity by enhancing job satisfaction. At the same time, other studies emphasise the need to consider both individual and organisational factors that may influence outcomes. Thus, examining the impact of flexible work schedules on employee productivity is important not only from the perspective of developing modern business practices, but also in the broader context of shaping new models of human resource management.

The issue of flexible work schedules has attracted the attention of many researchers seeking to understand their impact on employee productivity. For example, H. Chung & T. van der Lippe (2020) noted that a flexible approach to organising working hours enables employees to

better plan their personal lives, which has a positive effect on motivation and the quality of task performance. They emphasised that such an approach is particularly effective in creative or project-based organisations. Similarly, N.V. Shifrin & J.S. Michel (2022) concluded that flexible schedules help to reduce stress levels among employees, especially in large organisations, where high demands for rapid decision-making can lead to emotional burnout. In turn, N.-C. Liu & Y.-T. Lin (2021) focused on cultural aspects, finding that in collectivist cultures, schedule flexibility increases employee productivity only when aligned with team goals. The study by T.A. Williams *et al.* (2021) confirmed that employees who are given the opportunity to choose their own working hours demonstrate higher creativity and resourcefulness when solving complex tasks. Y. Lott (2020) drew attention to the gender dimension of flexible work, showing that women more often use flexible schedules to balance professional and family responsibilities, which leads to higher job satisfaction. However, he also noted that this could reduce the visibility of women's contributions to team activities. A.A. Davidescu *et al.* (2020) analysed how the introduction of flexible schedules affects the younger generation of employees, noting that for Millennials and Generation Z, flexibility is not only desirable but expected, and its absence may cause higher employee turnover. In addition, R. Sabuhari *et al.* (2020) investigated the impact of flexible schedules on organisational culture, finding that in companies where flexible working arrangements had become standard, employees showed greater loyalty to their employer and were more likely to remain with the organisation in the long term. The study by S.K. Parker & G. Grote (2022) focused on the technological aspects of flexible working, concluding that employees who used digital tools to coordinate work under flexible schedules achieved better results than those working in traditional formats. L.R. Soga *et al.* (2022) examined the impact of flexible working hours on interpersonal interactions within teams, noting that while flexibility promotes individual productivity, it may reduce team collaboration due to the lack of shared time for discussion and coordination. Finally, the study by M. Angelici & P. Profeta (2024)

demonstrated that the implementation of flexible working hours in large corporations led to significant reductions in office maintenance costs. However, they emphasised that the effectiveness of such changes depends largely on the quality of management and the level of support for communication among employees.

Previous research findings provide a solid foundation for further analysis, enabling a deeper understanding of the benefits, challenges, and mechanisms associated with the implementation of flexible work schedules in modern organisations. However, despite the extensive body of research, a number of important aspects concerning the impact of flexible work schedules remain insufficiently explored. For instance, limited attention has been given to examining the effects of flexible work schedules on productivity across different sectors of the economy. Moreover, there is a lack of studies focusing on the long-term implications of flexible working arrangements, particularly regarding employee career development and the formation of professional identity.

The aim of this study was to identify key factors influencing the impact of flexible work schedules on employee productivity, with the goal of developing recommendations for their effective implementation in the modern business environment. The objectives of the study were: (1) to analyse the specific effects of flexible work schedules on employee productivity across various economic sectors, and (2) to assess the long-term consequences of adopting flexible work schedules for enterprises.

MATERIALS AND METHODS

The study was based on an interdisciplinary approach, combining quantitative and qualitative analysis of the impact of flexible work schedules on labour productivity. To assess the influence of flexible work schedules on the productivity and well-being of employees in Ukraine, a survey was conducted among 500 respondents representing various industries, including IT, education, trade, the public sector, and industry. The survey was carried out anonymously via an online questionnaire from October to November 2024. Among the respondents, 55% were women and 45% were men. Regarding age, the

majority (60%) were aged 25 to 40, 25% were aged 18-24, and 15% were over 40. Geographically, survey participants were distributed between large cities (Kyiv, Kharkiv, Lviv, Dnipro, Odesa), representing 72% of respondents, and small towns and rural areas, accounting for 28%. This distribution allowed for the consideration of differences in access to infrastructure, working conditions, and other factors that may affect productivity and well-being. In terms of educational background, 42% of respondents held higher education degrees, 34% had secondary specialised education, and 24% had incomplete higher or secondary education. The marital status of respondents also varied: 41% had children, while 59% were childless or chose not to indicate whether they had children. The survey was conducted in accordance with the American Sociological Association's Code of Ethics (1997).

The questionnaire included both closed and open questions. The open-ended questions were: How do you rate your level of job satisfaction? How does flexible working affect your productivity? How has your stress level changed since switching to flexible working? What is your field of work? Where do you live? What is your marital status, and do you have children? What is your gender? What is your age? The closed questions included: What benefits have you personally experienced from switching to flexible working? What challenges have you faced with flexible working? How do you think flexible working affects work-life balance? What do you think employers can do to improve flexible working? How has the war in Ukraine affected your experience with flexible working?

To analyse the international experience of implementing flexible working hours, data were examined from countries that demonstrate successful examples of adopting this approach, including Sweden (Saha, 2024), Finland (Hours of work..., n.d.), the USA (Poydock *et al.*, 2024), Japan (McParlane, 2023), the Netherlands (Brega *et al.*, 2024), India (Deb, 2020), the UK (McParlane, 2022), Germany (Hybrid Work – a..., 2022), and Israel (Naor *et al.*, 2022). These countries were selected due to their diverse economic, social, and cultural characteristics, which enables a broad examination of various approaches to work organisation and an assessment of the

effectiveness of flexible working hours under different conditions. The analysis was conducted using a comparative method, allowing for the identification of common trends and unique characteristics specific to each country.

The study also analysed the experience of implementing flexible schedules in leading Ukrainian IT companies, such as SoftServe, Miratech, and DataArt. These organisations are characterised by a high level of digitalisation, which facilitates the effective adoption of innovative approaches to work organisation. To examine the legislative framework of Ukraine in relation to flexible work schedules, key regulatory legal acts were reviewed. These included the Labour Code of Ukraine (1971), Law of Ukraine No. 1213-IX “On Amendments to Certain Legislative Acts of Ukraine Regarding Improvement of Legal Regulation of Remote Work, Home-Based Work, and Work with Flexible Working Hours” (2021), and Law of Ukraine No. 2136-IX “On the Organisation of Labour Relations Under Martial Law” (2022). The analysis focused on changes associated with remote work, flexible schedules, and their impact on labour relations.

Furthermore, a systematic approach was applied to assess the impact of flexible schedules on labour productivity. Several conceptual frameworks were considered, including self-determination theory, which highlights the role of autonomy in fostering intrinsic motivation; the concept of work-life balance, which underscores the importance of harmonising professional and personal responsibilities; and the concept of organisational behaviour, which examines the influence of flexible schedules on team dynamics.

Statistical tools were employed to process the data, including descriptive statistics to analyse the distribution of respondents by category, correlation analysis to identify relationships between flexible work schedules and productivity, and regression models to assess the impact of various factors on employee well-being. The results of the sociological survey were analysed using descriptive statistics to determine averages, medians, and partial distributions. Correlation analysis enabled the identification of relationships between key parameters, such as productivity levels, job satisfaction, and stress levels. To ensure the relevance and validity of

the findings, the specific conditions of Ukraine were taken into account, including the impact of the war, the energy crisis, and general economic instability.

RESULTS

Flexible work schedules, which allow employees to adapt their working hours to their personal needs and lifestyles, are increasingly viewed as a tool for enhancing productivity. This phenomenon has attracted considerable attention in both scientific research and human resource management practice. One of the key concepts explaining the impact of flexible work schedules on productivity is self-determination theory, which posits that autonomy in task performance stimulates intrinsic motivation. Employees who are able to independently plan their working time experience a greater sense of control over their lives, which, in turn, leads to increased job satisfaction (Austin-Egole *et al.*, 2020). This improvement in satisfaction has a positive effect on both the quality and speed of task completion.

Another relevant approach is based on the concept of work-life balance. Flexible work schedules enable employees to harmoniously integrate professional responsibilities with personal priorities. For instance, parents can allocate more time to their children, while employees who prefer non-standard working hours, such as night shifts, can work according to their own preferences. This flexibility helps to reduce stress and prevent burnout, which are crucial factors for sustaining long-term productivity (Brough *et al.*, 2020). At the same time, the concept of organisational behaviour highlights that flexible schedules can positively influence not only individual performance but also team dynamics. Employees who enjoy greater autonomy in planning their work are often more proactive, showing initiative and a greater willingness to engage in new projects. However, such benefits can only be realised if effective coordination mechanisms are in place, supported by the use of modern digital tools for task management.

In addition, in creative and highly skilled sectors, flexible working hours are often particularly effective as they provide an environment conducive to idea generation and solving

complex problems. Conversely, in manufacturing industries, the effectiveness of flexible working hours may be limited by strict requirements for synchronising work processes (Destouet *et al.*, 2023). However, not all aspects of flexible working hours are unambiguously positive. According to the concept of resource conservation, excessive flexibility can create difficulties for employees who lack sufficient self-discipline or who are prone to procrastination. The absence of clear boundaries between work and personal time can lead to burnout and a decline in productivity (Kaduk *et al.*, 2019).

Furthermore, organisational culture plays a crucial role in the successful implementation of flexible working hours. Organisational culture encompasses the values, norms, and practices that shape how a company operates and how decisions are made. Organisations focused on innovation and collaboration are more likely to adopt flexible working hours, as such approaches promote creativity, adaptability, and employee loyalty. In these companies, flexible working hours are perceived not only as a tool for increasing productivity, but also as a means of supporting employee engagement and development. In contrast, conservative organisations, characterised by strict hierarchies or a strong emphasis on tight control over work processes, may view flexible working hours as a risk. In such environments, managers may fear losing control over task performance and worry about a decline in overall efficiency. For example, companies that adhere to a traditional 9-to-6 work schedule often underestimate the potential benefits of flexible arrangements, believing that such practices contradict core principles of organisational management.

Another important aspect to consider is the nature of the tasks performed by employees. In professions that require a high level of autonomy and creativity, flexible work schedules can significantly enhance productivity. For example, programmers, designers, scientists, and marketers, who typically work in environments with minimal routine tasks, benefit greatly from the ability to adjust their schedules to align with their natural work rhythms (Babapour Chafi *et al.*, 2021). Under such conditions, employees are often able to focus on

complex tasks during periods of peak productivity, thereby reducing the risk of burnout. Conversely, for tasks that depend heavily on synchronised teamwork, such as project management or customer service, flexible work schedules can introduce challenges. Employees working at different hours may experience difficulties in coordinating tasks, sharing information, or making collective decisions. In these cases, the effective implementation of flexible schedules requires the use of modern technologies for team management, including collaboration platforms and cloud-based tools.

Additionally, industry-specific characteristics play a significant role. In sectors such as services or manufacturing, where strict timeframes must be observed (e.g., transport schedules or retail opening hours), the scope for flexible working hours is limited. By contrast, in industries such as IT, education, or consulting, where the quality of outcomes is more important than adherence to fixed schedules, flexible working hours present an effective solution (Kazekami, 2020). Organisational culture also strongly influences employees' perceptions of flexible working hours. In companies that foster open communication, recognise achievements, and demonstrate trust in employees, flexible work arrangements are more likely to be perceived as a privilege rather than a burden. On the other hand, in organisations where a micromanagement culture dominates, the introduction of flexible work schedules may generate suspicion, conflict, and even resistance to change (Smith *et al.*, 2019).

Flexible working hours are being implemented in many countries, yet approaches to this work management tool vary considerably depending on cultural, economic, and social conditions. Scandinavian countries, such as Sweden, Norway, and Finland, are among the pioneers in adopting flexible working hours due to their social orientation and emphasis on employee well-being. In Sweden, many companies are experimenting with a six-hour workday, which allows employees to maintain high productivity through focused work within a shorter timeframe. Employees are thus given the opportunity to devote more time to family, hobbies, or leisure, which significantly reduces stress levels

(Saha, 2024). In Finland, employees have a legal right to flexible working hours, enabling them to decide when to start and end the working day, thereby promoting a better work-life balance (Hours of work..., n.d.).

The United States is recognised as a leader in the use of technology to facilitate flexible working hours. With the expansion of the IT sector and the growth of remote work, many companies now offer employees the freedom to choose when and where they work. Major corporations such as Google, Microsoft, and Salesforce provide conditions that enable flexibility, allowing employees to plan their schedules according to individual needs. According to a Gallup survey, the majority of American employees believe that the opportunity to work flexibly enhances their job satisfaction. Furthermore, the prevailing results-orientated culture in the United States supports the successful adoption of flexible schedules, as the focus is placed on achieving goals rather than simply working a set number of hours (Poydock *et al.*, 2024).

Japan, traditionally known for a corporate culture of long working hours, is gradually reforming its approach to work organisation. The Japanese government has introduced programmes aimed at reducing working hours and promoting flexible schedules as a means of addressing the serious issue of employee burnout (*karoshi*). A well-known example is Microsoft Japan's experiment with a four-day workweek, which resulted in a 40 percent increase in productivity. Such initiatives demonstrate that even in cultures with traditionally high expectations regarding working hours, new approaches can be effectively integrated (McParlane, 2023).

The Netherlands is considered one of the most progressive countries in the implementation of flexible working hours. National legislation allows employees to formally request adjustments to their work schedules, making flexibility not merely a corporate policy but a legally established right. The Netherlands also promotes a strong culture of work-life balance, enabling employees to feel valued and empowered to make independent choices (Brega *et al.*, 2024). As a result, the country demonstrates high levels of employee satisfaction and consistently low levels of burnout.

India, a global hub for outsourcing, is increasingly adopting flexible work schedules, particularly within the IT sector. A significant proportion of workers are employed by multinational companies, requiring them to adapt their working hours to the time zones of international clients. Flexible working conditions help Indian employees remain productive and competitive in the global marketplace (Deb, 2020). However, this approach remains inaccessible to many workers in traditional industries due to economic inequality and insufficient technological infrastructure.

The United Kingdom is also actively embracing flexible work schedules. The government promotes work-life balance, and many companies now offer employees the opportunity to work flexibly or remotely. Experiments with a four-day workweek have demonstrated positive effects on employee productivity and mental health (McParlane, 2022). In Germany, where strong trade unions play a significant role, flexible work schedules have been successfully implemented as a means of fostering a healthy work environment. Companies such as BMW and Siemens support their employees by allowing them to choose their working hours, contributing to increased employee loyalty and productivity (Hybrid Work – a..., 2022).

Overall, international experience illustrates that flexible work schedules contribute not only to enhanced productivity, but also to the harmonisation of professional and personal life. Although the implementation of these approaches varies according to local circumstances, general trends indicate a gradual shift in the global paradigm of work organisation. Table 1 presents a comparative overview of the impact of flexible work schedules on productivity in various countries. The results show that the implementation of flexible work schedules contributes to increased work efficiency, improved work-life balance, and reduced stress levels among employees. These approaches vary according to economic conditions and cultural traditions – from the four-day workweek in Japan to the legally enshrined right to adjust working hours in the Netherlands. Such international experiences demonstrate the potential of flexible work models for the modern business environment.

Table 1. The impact of flexible schedules on productivity in different countries

Country	Implementation examples	Results
Sweden	Six-hour workday in companies	25% increase in productivity, improved work-life balance
Finland	Legal right to choose schedule	Reduced stress, increased job satisfaction
USA	Remote work at Google, Microsoft	Increased employee satisfaction, reduced burnout
Japan	Four-day week at Microsoft Japan	40% increase in productivity, reduced employee stress
Netherlands	Legal right to change schedule	Reduced burnout, consistently high job satisfaction
India	Flexibility in IT companies	Efficiency increased by adapting to customer time zones
United Kingdom	Experiments with four-day week	Improved employee mental health, reduced stress
Germany	Flexible schedules at BMW, Siemens	Increased employee loyalty, efficient work organisation

Source: compiled by the author based on R. Deb (2020), P. McParlane (2022), Hybrid Work – a... (2022), M. Naor *et al.* (2022), P. McParlane (2023), R. Saha (2024), Hours of work... (n.d.), M. Poydock *et al.* (2024), C. Brega *et al.* (2024)

In light of global transformations, including the rapid development of technology, the COVID-19 pandemic, and increased focus on work-life balance, flexible work schedules are gradually gaining popularity in Ukraine. This trend is particularly relevant for businesses seeking to adapt to new challenges while maintaining competitiveness and ensuring high levels of employee productivity. Flexible work schedules have become even more relevant in the context of the war in Ukraine, where many companies have been forced to shift to remote working formats due to security threats. Under conditions of military operations and constant challenges, such as power outages and air raids, the adaptability of working hours has emerged as a key factor in preserving business operations and supporting employees. Nevertheless, the introduction of flexible forms of employment faces a number of challenges that affect the pace of their adoption.

The adoption of flexible work schedules addresses many pressing employment issues in Ukraine. For employees, flexibility offers the opportunity to organise their time more effectively. For example, in large cities such as Kyiv or Kharkiv, daily commuting to the office can take between two to four hours, significantly reducing productivity and quality of life. Flexible working hours or the possibility of remote work can greatly mitigate this negative impact. Moreover, flexible schedules are crucial for specific social groups, including parents raising children, students, and people with disabilities. For these groups, flexibility in choosing working hours provides equal opportunities for professional self-realisation. As international experience shows, such models also help reduce stress

levels, which is a key factor in preventing professional burnout (Borisikhina, 2024).

Despite its numerous advantages, the implementation of flexible working in Ukraine faces significant challenges. One of the key barriers is the low level of digitalisation among small and medium-sized enterprises (SMEs), which still account for a substantial share of the labour market. Many companies lack the necessary infrastructure to organise remote work, including corporate communication platforms and productivity monitoring tools. Another obstacle is the prevailing mentality of many employers, who continue to associate productivity with physical presence in the office. In such companies, flexible working is often viewed as a risk, potentially undermining managerial control over work processes. Equally important is the issue of legislative regulation. Although Ukraine has adopted a legal framework for organising remote work, existing legislation does not fully address the specific features of flexible working arrangements, leaving gaps in the protection of both employees' and employers' rights.

Nevertheless, large international companies operating in Ukraine, such as Microsoft, Deloitte, and EPAM, are actively implementing flexible working models for their employees. These companies demonstrate that such approaches can result in high productivity and strong employee loyalty, even in a dynamic and challenging business environment. Among Ukrainian companies, there is a gradual shift towards flexible work models, particularly in sectors such as information technology (IT) and the creative industries. For instance, IT companies like SoftServe and Miratech are actively introducing flexible working hours, enabling

employees to choose their schedules based on client needs, including collaboration across different time zones. Another notable example is DataArt, which offers employees both flexible working hours and remote work, allowing them to adapt work processes to their personal needs and schedules. However, in other sectors, such as industry and the civil service, this transition is much slower. The war in Ukraine has become a significant catalyst for the introduction of flexible working hours, as many companies have been forced to adapt their business processes to new and unpredictable conditions.

At the same time, in regions of Ukraine where military operations were less intense, such as the western regions, flexible working hours were introduced more rapidly and with greater benefits for employees, as infrastructure and access to technology remained relatively stable. Conversely, in areas that experienced intense military operations, including the eastern and southern regions, the introduction of flexible working hours was significantly more challenging due to the widespread destruction of infrastructure, and the lack of stable communications and electricity supply. Nevertheless, even in these regions, enterprises, particularly in the service and IT sectors, are making efforts to establish flexible working conditions to ensure the continuity of business processes, despite the absence of employees' physical presence at the workplace (Bezpalko *et al.*, 2024). Thus, the war in Ukraine has not only accelerated the adoption of flexible working hours but has also highlighted the critical importance of technological adaptation, enabling enterprises to remain operational in emergency situations.

In contrast, in Israel, where the level of digitalisation and infrastructure development was already high prior to the onset of conflict, flexible working hours have become a natural and integral part of the work culture. Israeli companies actively utilise flexible working schedules and remote work in sectors such as technology, education, and services. Even before the COVID-19 pandemic and recent conflicts, many Israeli companies had already implemented flexible work arrangements as a means of improving work-life balance for employees. Additionally, Israel's vibrant startup ecosystem often

incorporates flexible working conditions as a core element of corporate culture, fostering creativity and rapid innovation (Naor *et al.*, 2022). Therefore, while in Ukraine flexible working hours were largely introduced as a response to crisis conditions, in Israel they have evolved as a standard component of modern work practices, supported by technological advancement and government initiatives. Israel's experience in implementing flexible work schedules, particularly in the technology sector, offers valuable lessons for Ukraine, demonstrating how such models can effectively enhance business productivity and resilience, even during periods of instability and crisis.

One of the main challenges employees face when transitioning to flexible working hours is the risk of procrastination, as the freedom to distribute working time may lead to postponement of tasks or a lack of motivation to complete them. This issue is particularly relevant for employees who struggle to organise their workday without clearly defined working hours. The absence of constant supervision and fixed schedules can negatively affect productivity, as employees may not fully realise their potential without external control.

In Ukraine, legislation on flexible working hours is only beginning to adapt to the new demands of the modern labour market, although several important steps have already been taken in this direction. The primary legal document governing working hours is the Labour Code of Ukraine (1971), which includes provisions for flexible schedules, home-based work, and remote work, thereby partially addressing the needs of the contemporary labour market. In particular, Article 56 "Part-time work" allows employees, by agreement with the employer, to establish a part-time working day or week. This provision is especially relevant for employees who need to combine professional duties with other responsibilities, such as raising children or pursuing education. Article 60-1 "Home-work" regulates the performance of duties by employees outside the employer's premises, primarily from home, provided that appropriate conditions are ensured for fulfilling work tasks. Homework enables employees to reduce transportation costs and save commuting time, but it

also requires a clear definition of responsibilities for both parties involved in the labour process. Article 60-2 “Remote work”, introduced in response to new challenges, including the COVID-19 pandemic, governs the remote execution of work functions using information and communication technologies (ICT). Remote work allows employees to carry out their tasks from any location, provided they have access to the necessary resources. This creates new opportunities for organisations, particularly for ensuring business continuity during emergencies. Nevertheless, despite the existence of these legal provisions, Ukrainian labour legislation does not always keep pace with the rapid changes in the economy and technology. Although temporary regulations were adopted to address remote and home-based work arrangements during and after the pandemic, their application remains limited due to the lack of detailed regulatory guidelines and control mechanisms.

The Law of Ukraine No. 1213-IX “On Amendments to Certain Legislative Acts of Ukraine Regarding Improvement of Legal Regulation of Remote Work, Home-Based Work, and Work with Flexible Working Hours” (2021) provides the legal basis for applying flexible working hours, but lacks detailed regulation, which enables employers to implement these models inconsistently, depending on the industry. In this context, there is a pressing need for separate

regulatory acts specifically governing flexible forms of work, in order to create a unified and transparent framework. Additionally, the Law of Ukraine No. 2136-IX “On the Organisation of Labour Relations Under Martial Law” (2022) seeks to introduce clearer mechanisms for ensuring safe remote work and the application of flexible working hours under emergency conditions. However, several key issues remain unresolved, including the lack of specific guidelines for employer-employee interactions in flexible working arrangements and the uneven application of flexible schedules across different sectors of the economy. Thus, for the effective development and wider implementation of flexible work models in Ukraine, it is essential to establish a stable and comprehensive legal framework that regulates these forms of work across all sectors, ensuring equal conditions and rights protection for both employees and employers.

A survey conducted among 500 employees from various sectors in Ukraine revealed critical insights into the implementation of flexible work schedules, their impact on productivity and well-being, and the challenges faced by both employees and employers. The participants represented sectors including IT, education, trade, industry, and the public sector, enabling a comprehensive understanding of the situation from multiple perspectives. Table 2 presents a summary of the survey results.

Table 2. Survey results on the impact of flexible work schedules in Ukraine

Research parameter	Results	Comments
Prevalence of flexible working	48% of respondents work on a flexible schedule	Highest share among women (55%) and employees with higher education (54%). In IT 65%, among women 62%, among parents – 35%. Lowest in industry and public sector (15%)
Increasing productivity	75% of respondents noted an increase in productivity	Main reasons: avoiding traffic jams (60%), improving work-life balance (55%). The greatest effect is seen in women with children (35%) and workers in large cities (60%)
Areas where flexibility is most prevalent	IT (65%), education (50%), creative professions (40%)	Flexible working hours are most common among workers with higher education (62%) and in creative professions (40%). Due to the high level of digitalisation
Key challenges	40% of employees have difficulty planning their time; 20% experience a lack of team interaction	This is especially true for workers with children. The lack of interaction is most felt in rural areas.
Role of war in implementation	70% noted that the war was a catalyst for change	Factors: Air strikes, power outages, evacuations. Greater impact in eastern and southern regions, particularly among workers with children

Table 2, Continued

Research parameter	Results	Comments
Employer attitudes	80% of employees believe that their employers positively evaluate flexible schedules	Main benefits: increased satisfaction (60%), reduced turnover (45%), reduced sick leave (30%). More positively rated among employees in large cities and with higher education
Key groups that benefit	Parents (35%), creative professions (40%), workers in large cities (60%)	Flexible schedules allow for a more effective balance between professional and personal responsibilities, especially among parents and workers in large cities
Barriers to implementation	Low level of digitalisation in some industries; traditional approach to assessing productivity by employers	This is especially noticeable in industry and the public sector, where physical presence is perceived as an indicator of productivity. The lack of proper digital infrastructure is felt more by workers with secondary specialised education

Source: created by the author

According to the survey, 48% of respondents currently work under a flexible schedule or have the opportunity to partially adjust their working hours. The highest prevalence of flexible schedules is observed in the IT sector (65%), which is explained by the high level of digitalisation in this industry and its focus on results rather than processes. In the education sector, flexible schedules were implemented in 50% of cases, primarily for teachers who conduct classes at various times. In contrast, in the public sector and industry, only 15% of employees reported having the ability to choose a convenient work schedule, highlighting a low level of flexibility in these fields.

Among those working under a flexible schedule, the majority (75%) indicated that their productivity had increased. Notably, 60% reported that they were able to avoid stressful situations, such as long traffic jams during peak hours. Furthermore, 55% stated that flexible working hours had contributed to an improved work-life balance, allowing them to dedicate more time to family, hobbies, or recreation. This effect was particularly significant among employees with children, who could better balance work and family responsibilities. Creative workers also emphasised that flexible schedules enhanced both creativity and productivity. For instance, 40% of designers and writers reported being able to complete tasks more effectively in the evening or at night, which had not been possible under rigid work schedules.

Despite these positive outcomes, 40% of respondents working under flexible schedules identified challenges associated with this form

of employment. One of the main difficulties cited was effective time management. Employees with children mentioned the struggle to balance professional duties and home responsibilities, as children often require attention outside standard working hours. Another frequently mentioned issue was reduced communication with colleagues: 20% of respondents noted experiencing a lack of teamwork and collaboration, especially when working remotely. Employers also highlighted that assessing employee productivity under flexible working arrangements requires new tools and approaches, including key performance indicators (KPIs) and performance monitoring systems.

It is also important to highlight that 70% of respondents identified the war in Ukraine as the main incentive for the adoption of flexible work schedules. Due to frequent air raids, power outages, and the need for evacuation, many employers have provided employees with the opportunity to work remotely and to choose convenient times to complete their tasks. For example, employees of IT companies located in front-line areas reported being able to maintain high productivity thanks to an adaptive approach to work.

Furthermore, 80% of employees working under flexible schedules indicated that their employers positively assessed the outcomes of this approach. Employers most frequently noted an increase in employee satisfaction (60%), a reduction in staff turnover (45%), and a decrease in sick leave (30%). Nevertheless, some companies acknowledged that the implementation of flexible schedules requires substantial organisational changes, including the adaptation of

internal processes and the introduction of new technologies to support remote work.

The impact of flexible working hours on employee productivity also varies significantly between large cities and rural areas, largely due to differences in access to technology and infrastructure. In large cities, where there is a high level of digitalisation and well-developed remote work infrastructure, employees have greater opportunities to effectively utilise flexible working hours, contributing to enhanced productivity. Reduced commuting time, convenient home working conditions, and access to high-speed internet enable employees to focus more on tasks and achieve a better work-life balance. Conversely, in rural areas, where technological access is limited and infrastructure remains underdeveloped, flexible working hours often encounter challenges such as slow internet connections and insufficient access to modern communication tools, which can undermine work efficiency.

The survey results indicate that flexible working hours have the greatest impact on employees with children, particularly women, who are more likely to use flexibility to balance professional and family responsibilities. Compared to other groups, parents report a significant improvement in work-life balance, enabling them to better organise time for their families. At the same time, among younger employees (under 40), flexible working hours contribute to increased productivity, primarily due to the ability to avoid traffic congestion and work in comfortable conditions. Older workers (over 40) are generally less likely to adopt flexible work models, although those who do report an improvement in the quality of their work. Additionally, employees with higher education are more likely to have access to flexible working arrangements, whereas in small towns and rural areas, such opportunities are significantly limited due to infrastructure and technological barriers.

Overall, flexible working hours demonstrate significant potential to increase work efficiency and enhance employee satisfaction in Ukraine. Despite certain challenges, such as time management and communication issues, the majority of respondents evaluated flexible work models positively. The war in Ukraine has become a

catalyst for accelerating the adoption of flexible working, especially in industries already employing digital technologies. This underscores the need for further investment in digital infrastructure and the development of national policies that support the wider adoption of adaptive work models in Ukraine.

Flexible working arrangements should be considered an essential component of organisational policy for Ukrainian employers, given their positive impact on productivity, employee motivation, and business adaptability. Several key recommendations for employers to successfully implement flexible work models are identified: Firstly, it is necessary to identify roles and tasks most suitable for flexible working, particularly in sectors such as IT, marketing, and creative industries. For sectors with strict time requirements, such as manufacturing or the public sector, a hybrid (blended) working model can be adopted. It is essential to invest in digital infrastructure, including video conferencing platforms, cloud technologies, and project management tools, to enable effective remote work. In addition, employers must develop clear internal policies governing working hours, communication protocols, and performance evaluation methods to ensure transparency and accountability in flexible work arrangements.

Adapting staff to new working conditions is a critical step in ensuring the success of flexible work models. Therefore, training employees in time management and the use of relevant technologies should be systematically organised. Leaders and managers should also develop specific skills for maintaining employee motivation and monitoring performance remotely, which are essential in flexible working environments.

It is equally important to promote work-life balance through the introduction of psychological support programs, time management consultations, and, where necessary, additional leave days to prevent burnout and stress. Ensuring equal access to flexible working hours for all employees is essential, particularly for women balancing professional and family responsibilities, as well as employees with disabilities. In the context of wartime conditions, flexible working hours have become a necessity rather than a benefit. To support employees, employers can

compensate by providing home office equipment or organising safe workplaces in more secure regions of the country.

To minimise risks such as procrastination, lack of discipline, and reduced interaction between colleagues, it is crucial to implement clear rules for self-management, introduce effective time management techniques, and regularly organise team meetings. Setting clear goals and deadlines will also enhance employee focus and accountability. The use of online collaboration platforms and virtual meetings is essential to foster team spirit and maintain effective communication. Additionally, creating informal communication opportunities, such as virtual coffee breaks or social chats, will help reduce isolation among remote workers. To ensure that flexible working models remain effective, organisations should conduct regular employee surveys and monitor productivity and satisfaction levels, using this data to adjust company policies as needed. At the national level, the state should adapt labour legislation to better protect employee rights and promote flexible forms of work as part of modern employment standards. Ultimately, only a comprehensive approach, combined with investment in the development of flexible working models, will enable Ukrainian organisations to enhance their efficiency and competitiveness in a rapidly changing environment.

DISCUSSION

The results of the study confirm the importance of flexible work schedules as an effective tool for increasing productivity, improving work-life balance, and enhancing employees' adaptability to changing conditions. This approach to work organisation is becoming increasingly relevant in the context of global transformations affecting the social and economic environment. Flexible work schedules not only enable employees to better organise their time, but also contribute to creating a more comfortable and supportive working environment, which in turn positively influences overall job satisfaction.

One of the most notable effects of implementing flexible working hours is the enhancement of employees' sense of autonomy. Research shows that autonomy contributes to

higher motivation and improved task performance. This finding is consistent with modern motivation theories, particularly self-determination theory, which underscores the importance of freedom of choice and self-regulation in fostering intrinsic motivation. However, it is important to note that not all employees perceive flexible working conditions in the same way. In certain sectors, especially those where close team interaction is essential, the need for effective management of communication and collaboration between team members becomes more critical. This underscores the importance of adopting an adaptive approach to the design and implementation of flexible work schedules, tailored to the specific needs of different roles and sectors. Additionally, T.K. Ray & R. Pana-Cryan (2021) examined the impact of flexible work schedules on employees' mental health. Their research identified significant reductions in stress and burnout among employees who had the opportunity to adjust their working hours. These findings support the current study's conclusions on the role of flexible working in stress reduction, while also suggesting that the benefits of flexibility may be even more pronounced in occupations with high emotional demands.

The introduction of flexible working hours in the IT sector significantly enhances employee productivity and contributes to higher job satisfaction by enabling employees to independently plan their working time. The results of the present study indicate an overall positive impact of flexibility within the context of the high level of autonomy that is typical of the IT industry. A study by W.J. Conrادية & J.J. De Klerk (2019), which also focused on the IT sector, confirms the positive, albeit moderate, effect of flexible working hours on employee productivity. However, the authors noted that remote work did not always lead to increased efficiency, a finding that aligns with the current study's conclusion that flexibility must be accompanied by appropriate organisational support to be fully effective. Nevertheless, unlike the current results, W.J. Conrادية & J.J. De Klerk found that employee job satisfaction remained stable, without a significant increase. This discrepancy may be explained by cultural differences or variations in management practices within the companies examined.

The results of the current study further demonstrate that the implementation of flexible work schedules significantly enhances employees' job satisfaction and improves work-life balance. However, it is crucial to consider the specific nature of professions where such schedules are applied. This observation correlates with the findings of A. Füzi *et al.* (2022), who analysed the impact of flexible working hours on employees in creative professions, such as designers and copywriters. A. Füzi *et al.* found that flexibility in scheduling not only increases job satisfaction but also stimulates creative potential, which aligns with the conclusions of the present study. Nevertheless, unlike the current research, A. Füzi *et al.* did not explore in detail the influence of flexible schedules on employee innovation. In contrast, the findings of J. Yeves *et al.* (2022) also support the advantages of flexible schedules in professions where creativity and innovative thinking are essential. Their study suggests that adapting working hours to individual needs enables employees to identify their most productive periods for creative work, thereby significantly enhancing innovation capacity. This finding is consistent with the current study's emphasis on the importance of adapting working conditions to the specific requirements of professional activities.

Another key aspect of flexible working is its impact on work-life balance. Traditional work patterns often contribute to conflicts between work and personal life, particularly when employees are required to work long hours. Flexible working arrangements allow employees to better manage their time between professional and personal responsibilities, thereby reducing stress and improving quality of life. However, while flexibility offers clear benefits, it also presents potential risks. For instance, the blurring of boundaries between work and leisure can result in chronic emotional exhaustion if employees do not maintain clear separation between professional and personal time. This highlights the need for strategies to support employees in time management and self-discipline, ensuring that flexibility does not lead to overwork or burnout. A. Arlinghaus *et al.* (2019) analysed the impact of flexible working hours on employees' family life, with a particular focus on the education sector.

Their study found that flexible working schedules enabled employees to better balance work and family needs, supporting current findings that work-life balance is a critical factor in psychological well-being. However, L. Vyas (2022) observed that when employees had overly irregular schedules, flexibility could have the opposite effect, making it more difficult to plan family activities and maintain stability. Although this aspect was not specifically addressed in the present study, it emphasises the importance of a structured approach to implementing flexibility, ensuring that schedules remain predictable enough to support family life.

The role of flexible working in crisis situations is also of particular relevance. During periods of global disruption, such as pandemics or economic crises, many companies have been forced to restructure their work processes. In such contexts, flexibility has become a key factor in ensuring business continuity. It has been observed that organisations which had already implemented adaptation mechanisms, including flexible working arrangements, were better equipped to respond to new conditions. This underscores the importance of integrating flexible work models into long-term human resource strategies as a means of enhancing organisational resilience. Furthermore, M.A. Hashmi *et al.* (2023) examined how flexible working arrangements influence employee loyalty. Their research found that employees who had the opportunity to adjust their work schedules were less likely to consider alternative job offers. This aligns with current findings indicating that increased job satisfaction associated with flexible working can indirectly enhance employee loyalty. Interestingly, flexibility tends to be perceived most positively by younger generations, who value autonomy and adaptability, whereas older workers often place greater emphasis on stability. This generational difference highlights the need for tailored approaches to flexible working that take into account diverse employee preferences and life stages.

However, even when flexible working proves effective, challenges remain regarding its impact on team dynamics. Flexible working hours can complicate the synchronisation of team efforts, particularly in project-based activities

or when working to fixed deadlines. To address these challenges, companies should adopt effective communication and task management tools, including modern digital platforms. Additionally, it is essential to equip employees with the necessary skills to operate efficiently under flexible conditions, including proficiency in relevant technologies. N. Chanana & Sangeeta (2021) examined the impact of flexible working hours on team dynamics, noting that although flexible working provides individual benefits, it also creates difficulties in teamwork, particularly in coordinating the efforts of team members. These findings are consistent with the current study, which also highlights that flexible work arrangements can hinder interaction if specialised tools for coordination and communication are not employed. Further supporting this view, T. Van der Lippe & Z. Lippényi (2020) found that such challenges can be mitigated through the use of technologies, including shared platforms for planning and communication, a solution also recognised in the present research. These tools help streamline collaboration and maintain effective team functioning despite asynchronous working hours.

The implementation of flexible working hours has generally had a positive impact on employee productivity, particularly in office-based roles. This includes increased job satisfaction, better adaptation to personal needs, and reduced stress levels. Nonetheless, it is crucial to consider the context and specific nature of the work. For instance, R. Chen *et al.* (2020), in their study of flexible working hours in the manufacturing sector, found that flexibility is not always effective. In production line environments, where synchronous work and physical presence are essential, flexible working often had a negative impact due to coordination difficulties and the inability to perform tasks remotely. In contrast to the current findings, which highlight the advantages of flexible working in office-based settings, these results underscore that the characteristics of the job itself are a critical determinant of success when introducing flexibility. This further supports the argument that flexible working arrangements must be tailored to individual and organisational contexts, taking into account the specific nature of the tasks, the need

for synchronisation, and the availability of technological support.

CONCLUSIONS

Flexible work schedules help to increase employees' intrinsic motivation by promoting greater autonomy in their work. This finding is consistent with self-determination theory, which posits that the ability to independently plan and manage one's working time positively influences job satisfaction. Employees who have control over their schedules tend to demonstrate higher levels of loyalty, initiative, and overall task performance. Moreover, flexible working arrangements positively impact the balance between professional responsibilities and personal priorities, which is particularly crucial for socially vulnerable groups, including parents, students, and people with disabilities. The ability to choose working hours helps prevent burnout, reduce stress, and enhance long-term productivity.

International experience further confirms that the introduction of flexible schedules supports the harmonisation of work and personal life. For example, in Scandinavian countries, flexibility has led to reduced stress and higher job satisfaction. Experiments with a four-day working week in Japan and Iceland have demonstrated a significant increase in productivity, while in the USA, flexible schedules, supported by robust technological infrastructure, have become a key driver of employee loyalty. In Israel, flexible working hours are widely used in high-tech and healthcare sectors, helping employees adapt their schedules to individual needs and life circumstances.

However, challenges remain in the implementation of flexible working arrangements. In sectors requiring synchronised teamwork or strict deadlines, flexibility may cause coordination difficulties. Furthermore, organisational culture plays a pivotal role in the success of flexible working: companies that foster trust and autonomy among employees are generally more successful in implementing flexible arrangements than those dominated by micromanagement and rigid hierarchical structures.

In Ukraine, the introduction of flexible working hours is constrained by several barriers,

including insufficient digitalisation, traditional management approaches, and an underdeveloped regulatory framework. Nevertheless, the war has served as a catalyst for change, forcing many companies to adapt to new conditions by embracing remote and flexible work models. This situation highlights the critical importance of adaptability during crises. Despite these challenges, the findings of the present study show that the benefits of flexible working significantly outweigh its drawbacks. Flexible working not only enhances productivity but also contributes to fostering a positive corporate culture based on trust, openness, and innovation.

According to the survey, 48% of respondents currently work under flexible arrangements or have the option to adjust their working hours. The highest prevalence of flexible schedules is observed in the IT sector (65%) and education (50%), whereas the figures are much lower in the public sector and industry (15%). The majority of employees working under flexible schedules (75%) reported increased productivity. Additionally, 60% of respondents noted a reduction in stress due to avoiding peak-hour commutes, while 55% highlighted an improvement in work-life balance. However, 40% reported difficulties in organising their time, particularly those with children, and 20% indicated a decline in

communication with colleagues owing to the remote nature of flexible work.

Successful implementation of flexible working hours requires investment in digital infrastructure, the development of clear organisational policies, and employee training. It is also crucial to consider the specificities of each industry and ensure equal access to flexibility for different groups of workers, including those with family responsibilities and disabilities. Thus, flexible working hours represent a promising tool for increasing organisational efficiency and adapting to contemporary challenges, but they require a systematic organisational approach supported by government policy and labour law reform.

For future research, it would be valuable to conduct a more in-depth analysis of the impact of flexible working hours across different types of companies, as well as comparative studies in countries with varying economic conditions and levels of digitalisation, to better understand the global applicability of flexible working models.

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CONFLICT OF INTEREST

None.

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Вплив гнучких графіків роботи на продуктивність працівників в умовах сучасного бізнес-середовища

Анотація. Дане дослідження було направлене на вивчення впливу гнучких графіків роботи на ефективність виконання завдань працівниками та вивчення їх переваг та викликів. Методологія дослідження включала огляд практичних кейсів впровадження гнучких графіків у таких країнах, як Швеція, Фінляндія, США, Японія, Нідерланди, Індія, Великобританія, Німеччина та Ізраїль. Також проведено опитування серед 500 працівників різних галузей в Україні. Результати дослідження свідчать, що гнучкі графіки роботи сприяють підвищенню продуктивності, покращенню балансу між роботою та особистим життям, а також зменшенню рівня стресу серед працівників. Зокрема, у творчих та висококваліфікованих професіях гнучкість дозволяє працівникам адаптувати робочий процес до індивідуального ритму, підвищуючи якість та швидкість виконання завдань. Проте, у сферах, де важлива синхронізація роботи, таких як виробництво чи державна служба, впровадження гнучких графіків стикається з обмеженнями. Дослідження українського контексту показало, що війна стала каталізатором впровадження гнучких моделей зайнятості, зокрема у відповідь на виклики, пов'язані з повітряними тривогами, відключеннями електроенергії та вимушеною релокацією працівників. Опитування виявило, що 75% респондентів зазначили підвищення продуктивності завдяки гнучким графікам, тоді як основними викликами були планування часу та забезпечення ефективної командної взаємодії. Зроблено висновок, що успішне впровадження гнучких графіків залежить від рівня цифровізації, організаційної культури та адаптації до специфіки завдань. Рекомендовано інвестувати в інфраструктуру цифрових технологій, забезпечувати рівний доступ до гнучких форм зайнятості та проводити регулярний моніторинг їх ефективності. Отримані результати можуть бути корисними для розробки національних політик та управлінських рішень, спрямованих на адаптацію організацій до сучасних викликів

Ключові слова: автономія; інновації; організаційна культура; адаптивність; ризики та бар'єри



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Grain market in Ukraine: Financial and economic aspects

Abstract. The study focused on analysing the financial and economic performance indicators of agricultural enterprises in Kharkiv Region, with an emphasis on calculating production costs per unit and identifying the specific features of the grain sector. The methodology included data analysis from three enterprises with different organisational and legal forms: the private enterprise “Agro”, the farming enterprise “Zerniatko”, and the limited liability company “Barvinok”. For each of these, unit production costs were calculated for three main crops: wheat, maize, and barley. The findings revealed that the private enterprise “Agro” incurred losses in wheat cultivation due to high production

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costs exceeding the market price, highlighting the need to optimise agro-technological practices. Meanwhile, the farming enterprise “Zerniatko” demonstrated stable financial results thanks to a diversified income structure that mitigated market fluctuation risks. The limited liability company “Barvinok” achieved the highest profit per unit of output by specialising in barley cultivation and benefiting from favourable soil conditions. However, its narrow specialisation increased risks amid changing market conditions. For maize, the most profitable enterprise achieved a profitability rate of 1,000 UAH per tonne, while for barley it was 850 UAH per tonne. An analysis of income structures showed that diversified enterprises were more resilient to market volatility, whereas a high concentration on a single crop, as in the case of the barley-focused enterprise, posed additional risks. The analysis found that the level of financial efficiency depended on specialisation, land bank size, and the level of technological development. Enterprises with a more balanced production structure were better able to adapt to market changes, while focusing on a single crop could both increase profitability and introduce additional risks. The data obtained allowed for an assessment of the economic efficiency of each enterprise. The study's findings support effective management decisions aimed at minimising risks in Ukraine's grain sector

Keywords: land use; grain crops; agricultural market; financing; financial results; agribusiness; risks

INTRODUCTION

The grain market constitutes one of the fundamental pillars of Ukraine's agricultural sector. Grain crops occupy a central position in agricultural production and exports, ensuring a stable inflow of foreign currency and forming the basis of the country's food security. However, the development dynamics of this market are closely linked to financial and economic factors, such as changes in land use, the availability of financial resources, the effectiveness of state regulation, and the adaptability of agricultural enterprises amid global economic fluctuations.

Analysing the financial and economic aspects of the grain market is important for assessing the efficiency of land use and investments in the agricultural sphere. The threat of declining land fertility, changes in land policy, and the imperfect structure of agricultural markets all call for in-depth research. Existing studies highlight essential issues related to the efficient use of agricultural land, the grain market's ability to overcome economic challenges, and ensuring the sustainable development of agricultural production.

In the article by Ya.O. Krylov (2018), an economic assessment of the current state of Ukraine's grain industry was conducted, including an analysis of grain market supply formation. The author emphasised the importance of forecasting gross grain and legume yields until 2025, along with domestic consumption

volumes. Particular attention was paid to the factors most affecting wheat production efficiency and the application of multiple linear regression to analyse them. Krylov also proposed ways to improve the grain market regulation mechanism in Ukraine, taking into account current economic conditions and development prerequisites for the sector. The conclusions drawn were useful for further development of the grain market and for improving financial and economic strategies in the agricultural sector. This study highlighted the importance of a high-quality mechanism for state regulation and forecasting of production and consumption volumes, which is a vital component of Ukraine's agricultural market functioning.

Researchers R. Miroshnyk & I. Bahlai (2022) examined key problems of the grain market in Ukraine and developed paths for its future development. The authors described the current state of sown areas before and during the military aggression, analysing grain market indicators for the years 2015-2021, in particular sown areas, gross harvests, and yields. They also explored export trends for Ukrainian grain and grain procurement volumes by importing countries in 2020-2021. Miroshnyk & Bahlai identified the development prospects of the grain market, stressing the need for stabilisation of the military-political situation in the country and the material and technical support of

farmers. Special attention was given to negative factors affecting the Ukrainian grain market, along with proposed specific solutions that could promote further market development.

The study by O. Albeschenko (2022) explored the European experience in ensuring the sustainable development of the agricultural sector in rural areas. The author focused on regulation mechanisms and practices that enable effective management of rural development in the European Union and on ways to implement these practices in Ukraine. The article compared approaches to sustainable rural development across various European countries, particularly in terms of economic support for the agricultural sector, effective use of land resources, and rural infrastructure modernisation. Albeschenko underscored the significance of a comprehensive approach to agricultural sector development, including political stability, investment in agricultural technologies, and increased agricultural productivity. The article also addressed environmental sustainability tools such as biodiversity conservation and the application of “green” development principles in rural areas. The main conclusions highlighted the importance of adapting European experience to national conditions and challenges faced by Ukrainian agriculture.

In his 2019 study, O. Petrenko (2019) conducted a financial and economic analysis of the grain market in Ukraine, which is a prerequisite for ensuring national food security. The author examined in detail the factors affecting production volumes and the structure of grain production, emphasising the importance of this sector for the national economy. The article also analysed grain export opportunities and the potential for innovative production development. O. Petrenko identified key aspects crucial to formulating a development strategy for grain and legume crops.

The topic of the financial and economic aspects of the grain market is attracting considerable attention from researchers worldwide due to its relevance in ensuring global food security, stabilising economies, and supporting the sustainable development of the agricultural sector. Scholars analyse grain market dynamics, examining factors such as production efficiency, export potential, price volatility, and political

aspects. These studies highlight the universal importance of the grain market in addressing economic challenges and fostering development at both national and global levels. The study by J. Lawson *et al.* (2021) focused on analysing the impact of speculation on grain prices. The author examines the issue of volatility in the food grain market resulting from speculative activity, with particular emphasis on the financial mechanisms that drive such processes. The article presents theoretical models and empirical data that demonstrate the effect of speculative investments on price dynamics in the sector.

In his work, S. von Cramon-Taubadel (2022) focused on the impact of Russian aggression on grain markets and food security. The study considers the significant geopolitical and economic consequences associated with the crisis that began in February 2022. The author analyses how the disruption of Ukrainian grain exports due to the war has contributed to increasing global food insecurity. X. Xu & Y. Zhang (2021) investigated price fluctuations in the maize market across more than 182 local markets in seven major maize-producing states in the USA. The study employed correlation analysis, hierarchical clustering, and price synchronisation analysis. The authors identified interdependencies, heterogeneity in price synchronisation, and temporal changes in these processes. The findings reveal that the degree of price alignment increased after November 2006, although the trend was not consistently upward.

Thus, the analysis of the financial and economic aspects of the grain market remains a relevant area of research not only in Ukraine but also globally. The strategic role of the grain market in food security and its influence on economic development underscore the need to examine key trends, interdependencies, and regulatory mechanisms. The aim of this study was to assess the financial and economic factors influencing the functioning of Ukraine’s grain market, taking into account its structure, main risks, and potential directions for development.

MATERIALS AND METHODS

The research methodology was focused on the analysis of financial and economic indicators of three agricultural enterprises in Kharkiv Re-

gion as of 2024: the private enterprise Agro, the farm Zerniatko, and the limited liability company Barvinok (Opendatabot, n.d.). These enterprises were selected to represent a variety of organisational and legal forms and to allow for an in-depth examination of the grain sector based on three key aspects: area of agricultural land, financial efficiency, and the structure of income and expenditures. The farms operate on land areas ranging from 300 to 5,000 hectares and serve as representative examples of stable business models in the grain market of Kharkiv Region. They demonstrate long-term activity, consistent financial performance, and a high level of engagement in the regional agribusiness sector. One of the important indicators for analysing efficiency was grain crop yield, which made it possible to evaluate the productivity of land use for each enterprise. The standard methodology was applied for yield calculation, based on the ratio of harvested crop mass to the sown area. This ensured comparability of results even among enterprises with differing scales and agronomic practices (State Statistics Service of Ukraine, 2022).

The analysis covered three main crops – wheat, maize, and barley. Wheat was chosen due to its importance as a staple crop for many farms and its sensitivity to climatic conditions, which allowed for an assessment of how enterprises adapt to changing environmental factors (Law of Ukraine No. 1469-VIII, 2016). Maize, being highly productive and profitable, enabled the study of how businesses ensure both yield and economic efficiency under different levels of mechanisation and technological advancement. Barley, being less demanding in terms of growing conditions, offered insight into the specifics of cultivation technologies and facilitated comparative analysis of resource efficiency on simpler crops.

These crops are important not only from an agronomic standpoint but also financially, as they constitute a significant share of agricultural enterprise revenues and serve as the main source of profit. Crop yield is a key indicator in assessing land use efficiency. Within this study, yield was calculated using the following standard formula:

$$Y = \frac{Q}{A}, \quad (1)$$

where: Y – yield (tonnes/ha); Q – harvested crop mass (tonnes); A – sown area from which the crop was obtained (ha).

This formula provided a universal approach for evaluating the efficiency of each enterprise, regardless of production scale or landholding characteristics. The primary data for these calculations were obtained from enterprise production reports, which include information on total crop harvest and the areas used for cultivation. This method allowed for accurate comparisons among farms of various sizes.

Revenues from agricultural product sales were calculated as follows:

$$D = Q * P, \quad (2)$$

where: D – revenues from product sales (thousand UAH); Q – volume of products sold (tonnes); P – average price per tonne of product (thousand UAH).

This formula made it possible to determine enterprise revenues from grain sales, taking into account both sales volume and market price per unit.

The calculation of production cost per unit was also a key indicator of economic efficiency in agricultural production. This measure allowed for the assessment of the costs required to produce one tonne of agricultural product and facilitated comparisons across enterprises with different scales of operation and technological capacities.

The formula used was:

$$Wu = \frac{Z - P}{V}, \quad (3)$$

where: Wu – unit loss (UAH/tonne); Z – total production costs (UAH); P – income from product sales (UAH); V – volume of products sold (tonnes).

The value of this indicator is multifaceted, as it provided insight into enterprise productivity, the efficiency of resource use (both material and financial), and the competitiveness of products in the market. Furthermore, the analysis of unit costs considered the impact of technological factors such as mechanisation level, soil cultivation methods, and seed quality.

Data of land use were obtained from open data services of the State Land Cadastre (Opendatabot, n.d.; Open Data of the Land Cadastre

of Ukraine, n.d.). The analysis included extracts from the public cadastral map (Open Data of the Land Cadastre of Ukraine, n.d.) containing information on land types (arable land, pastures, hayfields), plot sizes, lessees, and designated land use. This information enabled the assessment of land use scale and the role of each enterprise in the local agricultural market. Particular emphasis was placed on land use structure, which is a critical factor in forming economic efficiency.

Financial and economic indicators were analysed based on financial statements and open data on the income and expenditure of each enterprise (State Statistics Service of Ukraine, n.d.). Key indicators considered included profitability, total profit, and production expenses, including costs for sowing campaigns, equipment maintenance, fertilisers, and transportation services. Additionally, the structure of financing – comprising loans, investments, and internal resources allocated for production – was studied.

The study took into account changes in grain prices and their impact on the financial performance of the enterprises (State Statistics Service of Ukraine, n.d.). A correlation analysis was conducted to establish the relationship between profitability and market grain prices. The research also evaluated the financial stability of the enterprises, reflecting their ability to adapt promptly to market fluctuations. The analysis was conducted using modern statistical methods. To compare key indicators, Student's t-test

was employed, which allowed for the identification of statistically significant differences between the enterprises under study. Correlation analysis was used to identify relationships between land area, expenditures, and profits.

Microsoft Excel and Statistica were used as tools for data processing and visualisation. These programmes enabled the construction of graphical models illustrating the comparison of enterprise results and facilitated multifactorial analysis. In particular, tables and charts were created to reflect the dynamics of financial indicators, their correlation with land use area, and the role of enterprises in the regional grain market.

RESULTS

One of the key factors determining the economic efficiency of agricultural enterprises is the area of land they own or lease. Land is the primary resource in agriculture, and its size largely determines the potential for the use of modern cultivation technologies and for increasing productivity. Enterprises with larger land areas are able to implement intensive farming methods, adopt advanced agrotechnologies, and focus on mass production. For a more accurate assessment, the land area of each enterprise was examined based on data from the State Land Cadastre (Open data of the land cadastre of Ukraine, n.d.) and the Opendatabot service (n.d.). Table 1 presents the land resources owned or leased by three agricultural enterprises in Kharkiv region.

Table 1. Land resources of the surveyed enterprises as of 2024 (ha)

Enterprise	Owned land (ha)	Leased land (ha)	Total area (ha)
PE "Agro"	115	1,192	1,307
FE "Zerniatko"	95	608	703
LLC "Barvinok"	342	4,678	5,020

Source: developed by the authors based on Opendatabot (n.d.) and Open data of the land cadastre of Ukraine (n.d.)

Based on the data in Table 1, it is evident that the total land area of each enterprise differs significantly. LLC "Barvinok" holds the largest land bank – 5,020 ha, the majority of which (4,678 ha) is leased, allowing for large-scale production. PE "Agro", with 1,307 ha, relies mainly on leased plots, although it owns 115 ha of land. FE "Zerniatko" operates on the smallest land area (703 ha), where leased land also constitutes the majority, with 95 ha in ownership.

PE "Agro" utilises 1,307 ha of land, of which 92% is leased. This structure enables the enterprise to adapt its operations to leaseholder conditions but results in a high level of dependency on partners. The limited proportion of owned land may constrain long-term investment decisions, yet it offers greater flexibility in addressing short-term financial and economic challenges. The small-scale enterprise FE "Zerniatko" possesses a land bank of 703 ha, of which

608 ha is leased. A high proportion of leased plots allows for greater flexibility but restricts strategic capacity. Through effective resource management, FE “Zerniatko” is able to focus on high-efficiency land use and the implementation of local innovations, enabling it to maintain competitiveness even on a smaller scale. LLC “Barvinok” holds a dominant position in terms of land area – 5,020 ha, of which 4,678 ha are leased. The enterprise enjoys considerable advantages owing to its scale, which facilitates the application of modern agrotechnologies. However, dependency on leaseholders remains a key long-term risk factor. Successful optimisation of production processes allows for high financial returns, even with such a ratio of ownership to lease. The analysis of land resources demonstrates that land area significantly affects the economic sustainability of enterprises. LLC “Barvinok”, with the largest land bank, effectively utilises large areas for the introduction of intensive technologies. Smaller enterprises, such as FE “Zerniatko”, have the opportunity to focus on the most rational use of limited resources.

The data show that land leasing plays a dominant role in the land structure of the enterprises, creating both opportunities and risks for their development. A balanced combination

of leased and owned land enables enterprises to align short-term adaptability with long-term investment strategies. This is a key factor in enhancing financial stability and operational efficiency in the current economic climate. The following is an example of yield calculations for various crops cultivated by the surveyed enterprises. The wheat yield for PE “Agro” was calculated as follows: the farm harvested 5273 tonnes of wheat from an area of 879 ha. The yield was calculated using formula (1):

$$Y_{\text{wheat}} = \frac{5273}{879} \approx 5.99 \text{ tonnes/ha.}$$

The maize yield for FE “Zerniatko” was based on a total harvested volume of 3124 tonnes from an area of 504 ha. The calculation is as follows:

$$Y_{\text{maize}} = \frac{3124}{504} \approx 6.20 \text{ tonnes/ha.}$$

The barley yield for LLC “Barvinok” was calculated based on 4286 tonnes harvested from 1198 ha. The calculation is as follows:

$$Y_{\text{barley}} = \frac{4286}{1198} \approx 3.58 \text{ tonnes/ha.}$$

The calculated yield results are summarised in Table 2.

Table 2. Grain crop yield across the surveyed enterprises

Enterprise	Crop	Sown area (ha)	Harvest (tonnes)	Yield (tonnes/ha)
PE “Agro”	Wheat	879	5,273	5.99
FE “Zerniatko”	Maize	504	3,124	6.20
LLC “Barvinok”	Barley	1,198	4,286	3.58

Source: developed by the authors based on Opendatabot (n.d.) and Open data of the land cadastre of Ukraine (n.d.)

The calculated yield indicators show notable variation depending on the crop and enterprise. FE “Zerniatko” demonstrated the highest maize yield (6.20 tonnes/ha), indicating efficient cultivation and likely intensive use of agrotechnical methods. PE “Agro” showed a fairly high wheat yield (5.99 tonnes/ha), which may reflect soil quality and crop care practices. LLC “Barvinok” had the lowest barley yield (3.58 tonnes/ha), possibly due to specific climatic conditions, less fertile soils, or reduced investment in modern technology.

Yield calculations enable the assessment of the effectiveness of individual enterprises and

their prospects for productivity improvement. Enterprises with lower yield indicators are advised to review their agrotechnical practices and explore opportunities to adopt modern innovations to improve future outcomes. The data obtained suggest that yield levels are significantly influenced by the application of innovative technologies and by land resource management strategies. Large enterprises such as LLC “Barvinok” demonstrate higher efficiency due to economies of scale and production modernisation. At the same time, smaller enterprises like FE “Zerniatko” maintain competitiveness by ensuring stable yields on smaller plots. Further

research could focus on identifying technologies that enhance yields in medium- and small-scale farms (APK-Inform, n.d.).

In calculating the key financial aspects of agricultural enterprises, particular importance is attached to the analysis of the volume of

products sold and the average price per tonne. These indicators allow for the assessment of enterprise efficiency within market conditions, as well as their competitiveness depending on the crop. The data on product sales by the studied enterprises are presented in Table 3.

Table 3. Volume of products sold and average price per tonne

Enterprise	Crop	Volume sold (tonnes)	Average price per tonne (thousand UAH)
PE "Agro"	Wheat	5,200	9.00
	Maize	1,500	10.40
	Barley	900	7.00
FE "Zerniatko"	Wheat	3,000	9.10
	Maize	3,100	10.50
	Barley	1,400	7.00
LLC "Barvinok"	Wheat	2,800	9.00
	Maize	2,000	10.10
	Barley	4,200	7.00

Source: compiled by the authors based on Opendatabot (n.d.) and Open Data of the Land Cadastre of Ukraine (n.d.)

The total revenue from sales for each enterprise and crop is illustrated in Figure 1. This indicator, calculated using formula (2), is significant as it demonstrates the ability of enterprises to efficiently use resources, generate added

value, and adapt to market conditions. Revenue values provide insight into the financial stability of agricultural enterprises and determine future opportunities for investment in technologies or production expansion.

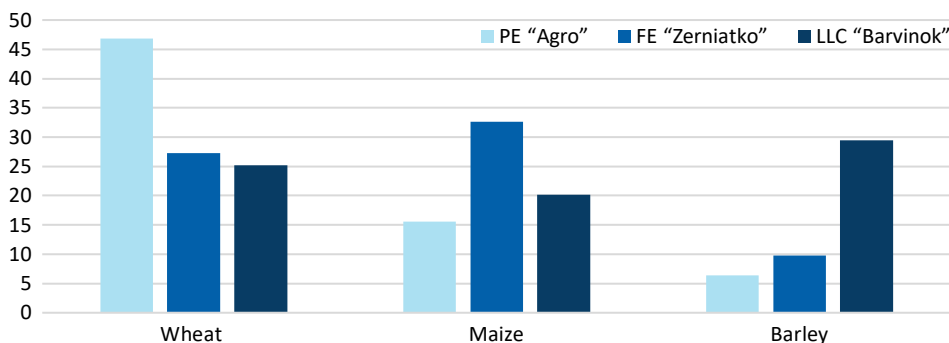


Figure 1. Revenue from product sales by the studied agricultural enterprises in 2024 (million UAH)

Source: compiled by the authors based on Open Data of the Land Cadastre of Ukraine (n.d.) and R. Mirosnyk & I. Bahlai (2022)

Wheat accounts for the majority of PE "Agro"'s revenue, providing more than 65% of total income. However, despite the significant volume of wheat sales, PE "Agro" incurred losses from wheat cultivation due to high production costs per unit compared to the market price. This indicates potential issues in the efficiency of agrotechnical practices and the need to

optimise costs to ensure profitability in the future. Thanks to a more balanced income structure, FE "Zerniatko" is not dependent on a single crop and is better equipped to cope with market fluctuations. Revenues from maize and wheat are at roughly the same level, which helps mitigate financial risks in a volatile market. This proves that diversification is an effective

agricultural strategy, as it reduces the impact of negative factors on a single crop.

LLC “Barvinok” achieves the highest profit per unit through barley cultivation. Favourable soil conditions and larger production scales contribute to this result. However, a focus on a single crop may pose risks in the event of market changes or adverse weather, so in the long term, diversification should be considered. The differing approaches of the enterprises to income structuring are determined by the specifics of the crops grown. PE “Agro” is vulnerable due to high wheat production costs, while FE “Zerniatko” avoids financial issues through diversification, and LLC “Barvinok” ensures profitability through barley but faces greater risks due to limited specialisation.

It is impossible to fully assess the financial and economic aspects of agricultural enterprises without considering losses per unit of production. This indicator allows for a comparison of resource use efficiency regardless of production scale. In particular, the analysis of losses per unit is critical for identifying weaknesses in production and economic processes, assessing enterprise competitiveness, and developing cost-optimisation measures. This approach makes it possible to compare the indicators of different enterprises regardless of differences in gross output or income, as it focuses on cost efficiency per tonne of production. An example

of the calculations for the three enterprises is provided below. Calculation of unit loss for PE “Agro” (wheat cultivation):

$$W_u = \frac{48500 - 46800}{5200} = 0.33 \text{ thousand UAH/tonne.}$$

This figure indicates a loss of 330 UAH per tonne of wheat, showing that costs exceeded revenue.

Calculation of unit loss for “Zerniatko” (maize cultivation):

$$W_u = \frac{29500 - 32600}{3100} = -1.00 \text{ thousand UAH/tonne.}$$

A profit of 1,000 UAH/tonne was achieved, indicating production efficiency.

Calculation of unit loss for LLC “Barvinok” (barley cultivation):

$$W_u = \frac{27300 - 29400}{4200} = -0.50 \text{ thousand UAH/tonne.}$$

The profit amounts to 500 UAH/tonne, also demonstrating a positive financial outcome.

For a deeper analysis of unit losses, calculations using formula (3) were carried out for the three agricultural enterprises in Kharkiv Region, using indicators of costs, revenue, and sales volumes of wheat. All values are presented in Table 4, which shows the variation in unit loss indicators between enterprises, taking into account their scale of activity and production efficiency.

Table 4. Unit losses, thousand UAH/tonne

Enterprise	Crop	Volume sold, t	Sales revenue, mln UAH	Costs, mln UAH	Unit loss, thousand UAH/tonne
PE “Agro”	Wheat	5,200	46.8	48.5	0.33
	Maize	1,500	15.6	14.8	-0.53
	Barley	900	6.3	6.5	0.22
FE “Zerniatko”	Wheat	3,000	27.3	26.2	-0.37
	Maize	3,100	32.6	29.5	-1.00
	Barley	1,400	9.8	10.0	0.14
LLC “Barvinok”	Wheat	2,800	25.2	25.0	-0.07
	Maize	2,000	20.2	18.5	-0.85
	Barley	4,200	29.4	27.3	-0.50

Source: compiled by the authors based on Opendatabot (n.d.) and Open Data of the Land Cadastre of Ukraine (n.d.)

PE “Agro” incurred a loss in wheat cultivation amounting to 330 UAH/tonne, which can be at-

tributed to high production costs exceeding the revenue from sales. A significant factor is the

unfavourable ratio between production costs and market prices. The issue may lie in an insufficient level of mechanisation and technological processes, resulting in high labour costs and expenditures on creating suitable growing conditions. Compared to wheat, maize and barley cultivation proved to be more profitable, as their production costs were significantly lower, while market prices remained consistently high. For instance, maize generated a profit of 530 UAH/tonne, indicating that farmers managed to organise agrotechnical operations effectively and find optimal cost-reduction solutions. Barley also delivered a positive financial result (220 UAH/tonne). However, the loss on wheat suggests the need to revise the enterprise's technical policy, as the high profitability of other crops demonstrates the enterprise's potential to achieve profitability when growing conditions are improved.

For the farming enterprise "Zerniatko", by contrast, all cultivated crops proved to be profitable. Maize emerged as the most profitable crop, which can be explained not only by market prices for this crop but also by effective cost management. A profit margin of 1,000 UAH/tonne allows the conclusion that the enterprise succeeded in establishing highly productive use of agricultural technologies, as well as making sound decisions regarding the organisation of the work process and the application of fertilisers, which influenced yields. Maize, being one of the most popular and economically advantageous crops in Ukraine, generates significant income if favourable conditions for its successful cultivation are ensured. The cultivation of wheat and barley also yielded positive financial results, although their profitability was lower compared to maize. This may indicate that the enterprise selected an appropriate strategic plan and invested in technologies that positively influenced the growth and development of cereal crops.

The company "Barvinok" LLC also demonstrated stable financial results, with the highest profit per unit of production recorded for maize – 850 UAH/tonne. This enterprise succeeded in significantly reducing production costs, likely due to improved technological processes and a higher level of mechanisation. Moreover, it is worth noting that the successful implementation of advanced agrotechnologies

(e.g. crop rotation or specialised fertilisers) may also have enhanced production efficiency. Similarly to "Zerniatko", "Barvinok" LLC managed to achieve profitability across all cultivated crops. Therefore, it is likely that the enterprise employs a comprehensive approach to development and strategic management, which ensures high performance even in the cultivation of less popular crops such as barley.

The data obtained highlight the importance of optimising costs and increasing yields as key factors in the financial sustainability of enterprises. From a financial and economic perspective, the enterprises demonstrate the capacity to adapt to changing market conditions by leveraging their comparative advantages in the cultivation of specific crops. Such analysis is essential for strategic planning by agricultural producers, as it enables the identification of weak points in the product realisation system and provides a foundation for further financial decision-making.

Having analysed the key performance indicators of the selected enterprises, a number of conclusions can be drawn regarding their efficiency and operational characteristics. The research findings suggest that the scale of the land bank has a significant impact on the ability of enterprises to implement modern technologies and use resources effectively. The highest yields are demonstrated by enterprises that apply intensive farming methods. At the same time, the structure of product sales and the average price per tonne underscore the economic differences between crops and enterprises, which considerably affect the overall financial outcome.

The significant volumes of maize sales by "Zerniatko" indicate a strategy focused on high-profitability crops, whereas the emphasis of "Barvinok" LLC on barley demonstrates regional specificities and the effectiveness of crop selection. The overall revenues of the enterprises confirm that wheat remains the main source of financial inflows, but diversification in agricultural production helps to minimise risks. The results obtained not only describe the current situation but also create a basis for a deeper analysis of the reasons behind enterprise successes or failures. This allows a focus on structural factors, market risks, and development prospects of the grain sector.

DISCUSSION

The results of the conducted study confirm the key role of financial and economic aspects in the functioning of the grain market. The analysis of the dynamics of yields, sown areas, export volumes, and financial indicators allows the conclusion that these elements are decisive for the stability and competitiveness of the sector (Ministry of Agrarian Policy and Food of Ukraine, n.d.; Resolution of the Cabinet of Ministers of Ukraine No. 1020, 2023).

The study emphasised that grain production largely depends on regional natural and climatic conditions, the effectiveness of agrotechnical measures, and the application of modern biometric and economic approaches to performance assessment. The conducted analysis confirms the necessity of using adaptive cultivation technologies to ensure high yield indicators, especially in the context of changing agro-climatic characteristics. Attention to sown areas and biometric parameters made it possible to identify the most productive solutions under real agricultural conditions, considering regional-level resources.

The results identified in the study point both to confirmation of conclusions made by other authors and to certain differences. Summarising the obtained data, it may be asserted that they partly correlate with previous works by foreign scholars who focused on the role of financial and economic factors in the functioning of the global grain market. However, the present study places greater emphasis on the regional context and the natural and climatic characteristics of Ukrainian conditions. These aspects require detailed analysis, which will be considered below, starting with a review of foreign studies.

The study by A.M. Martins (2024) examined the short-term market response to the war in Ukraine and its impact on agricultural markets. The author shows that supply restrictions led to a significant rise in grain prices. Furthermore, negative abnormal returns on the market were identified following the signing of the grain initiative agreement and other key events. Comparing this with the current study, one can note some parallels concerning the importance of external factors' impact on the agricultural sector, particularly economic and geopolitical

shifts. However, unlike the work of A.M. Martins, which focused on short-term market reactions, the current research provides a deeper focus on long-term economic processes and the adaptation of taxation mechanisms to the specific challenges posed by war.

The study by G. Abuselidze (2021) focused on the use of hedging to minimise risks in agricultural markets, particularly using the example of Georgia's grain market. The author stressed the importance of introducing advanced regulatory instruments to reduce risks caused by seasonality, fluctuations in production volumes, and natural and climatic conditions. It was noted that hedging may serve as a key tool for protection against price fluctuations, which is especially important in the agricultural sector, where product prices often depend on these factors. In the current study, this aspect of hedging could be applied to analyse Ukraine's grain market, as the country faces similar challenges, particularly seasonality and yield unpredictability. Overall, G. Abuselidze's work highlighted the need to adapt financial instruments to reduce economic risks in the agricultural sector. A comparison of such instruments for the grain markets of Ukraine and Georgia helps to understand how crucial their role is in developing market stability and ensuring reliable supplies to both national and international markets.

In the study by S. Kohlhase & J.L. Wielhouwer (2023), the role of the head office and business units in tax and customs planning processes through transfer pricing was analysed. The authors examine mechanisms for optimising taxes and customs duties through the establishment of transfer prices between company divisions. This allows companies to minimise tax expenses and enhance the efficiency of international trade. For Ukrainian agricultural enterprises, particularly in the grain market, such planning can be an important element for optimising financial flows and managing tax risks, especially under changing external economic conditions. Transfer pricing can serve as a tool for reducing the tax burden when entering international grain markets, thereby increasing the competitiveness of Ukrainian products. This study highlights the significant role that transfer pricing management plays in the globalised economic

space in the context of international trade relations, underscoring the need for the prudent application of such approaches to improve the financial and economic stability of national markets, especially the grain market.

Researchers B. Kalinowska & P. Bórawski (2024) analysed the factors influencing grain prices in Poland from 2005 to 2023. The authors applied multiple regression analysis to identify the key factors shaping wheat and rye prices. Among these factors were the areas of land used for grain cultivation, yield, grain production volumes, grain imports and exports, as well as domestic grain consumption. The study showed that wheat prices in Poland are significantly influenced by global trends in grain markets, which is also confirmed by the impact of global yield fluctuations and wheat cultivation areas on domestic price levels. In contrast, rye prices are influenced by the area under cultivation and domestic bread consumption. The decline in livestock production in Poland has led to a reduced demand for rye as animal feed. The study also emphasises the importance of external economic factors in shaping grain prices, which is relevant for analysing the financial and economic aspects of the grain market in Ukraine. As in Poland, global grain prices, changes in yields, and production volumes significantly impact price levels, which underscores the importance of effective risk management for Ukrainian farmers in the international grain market.

In the study by F.C. Ljungqvist *et al.* (2022), the impact of climatic variations on grain prices in early modern Europe was analysed. The authors stress the significance of climatic factors for the price dynamics of cereals, particularly the relationship between extreme weather events and yield fluctuations. It was found that weather phenomena such as droughts and excessive rainfall significantly affected grain price changes in Europe. This study uses long-term historical data to assess how weather conditions influenced market grain prices, introducing instability into production cycles. Unlike the current study's broader European context, which focuses on the financial and economic aspects of Ukraine's grain market, the main emphasis of Ljungqvist *et al.* is on the historical and climatic analysis of grain price volatility in European

markets. Thus, the Ukrainian study centres on economic pricing mechanisms related to local production conditions and international trade aspects, whereas the authors of this work examine price changes due to climatic factors. Moreover, although both studies highlight the importance of global market conditions, the Ukrainian context places greater emphasis on a broader spectrum of financial and economic factors.

Researchers M.J. Iqbal *et al.* (2022) studied the factors influencing the nutritional value of wheat, particularly agronomic conditions and cultivation methods that ensure high product quality. The authors emphasised the need to improve cultivation technologies and agricultural policies to enhance the nutritional properties of wheat. Compared to the present study, which focuses on the financial and economic aspects of the grain market in Ukraine, this research is more oriented toward agronomy and practical methods for improving grain quality. At the same time, the importance of ensuring grain quality, increasing yields, and adapting technologies to the conditions of specific Ukrainian regions is also reflected in the study focused on the agronomic aspect of grain production.

O.M. Smith *et al.* (2019) conducted a global meta-analysis confirming that organic agriculture offers significant environmental benefits but is accompanied by greater yield fluctuations compared to conventional farming. They found that organic methods can increase resilience to certain environmental factors but also significantly reduce productivity in some regions. This study is important for the current analysis of the grain market, as it highlights the challenge of ensuring stable supply and pricing in the industry amid unstable yields. The key difference lies in the fact that this study focuses on the advantages and disadvantages of organic agriculture as a whole, whereas the current study is centred on the financial and economic aspects of grain production and trade in Ukraine under changing market conditions and techno-economic approaches within the country.

Studies by Ukrainian authors focus on the internal aspects of regulating the agricultural market and economic mechanisms, while international sources emphasise global trends and factors influencing the grain market,

comparing them across different countries. This reflects a difference in approaches: in Ukraine, more attention is paid to national specificities and policy. In the study by S. Moshenskyi *et al.* (2024), agricultural and resource economics in Ukraine were examined in light of economic growth challenges. These aspects correspond to the new study focused on the grain market within the context of the economy, although the research emphasis differs – in the Ukrainian case, the general issue of economic growth in the agricultural sector is of greater significance.

Researchers A. Kucher *et al.* (2021) provided a detailed analysis of the economic impact of soil erosion on agriculture in Ukraine, particularly on declining land fertility and the production capacities of agricultural enterprises. They emphasised the importance of natural factors in ensuring the sustainable development of agricultural production but did not consider the impact of these processes on financial aspects, such as soil restoration costs or the adaptation of production to changing environmental conditions. In contrast, the presented study focuses on analysing the economic mechanisms of the grain market, specifically the effectiveness of financial strategies of agricultural enterprises managing these lands and the impact of external economic factors on their operations.

In the work by I. Makarenko *et al.* (2022), attention was drawn to the transparency of agricultural companies as a key factor for ensuring sustainable development and attracting investment. The study highlighted the importance of effective management, corporate social responsibility, and transparency in reporting for capital attraction, particularly in agribusiness. In comparison with the present study, which focuses on the financial and economic aspects of the grain market, Makarenko's work is more focused on institutional and corporate foundations that contribute to the effective functioning of enterprises but does not include an analysis of specific economic aspects of the grain market, such as costs, profitability, and financial risks faced by agricultural enterprises at various stages of the production process.

The research by M.V. Dykha *et al.* (2023) and I. Kyryliuk & A. Trokhymenko (2021) focused on grain pricing in Ukraine, particularly on the role

of state regulation and contractual relations that determine grain prices in the domestic market. By analysing the impact of government policy, the authors identified key trends in pricing that may help enterprises adapt to market changes. However, this research does not cover the broader aspects of grain market functioning, particularly financial risks and economic strategies of enterprises, which constitute the main theme of the present study. The current work has examined in greater depth not only pricing but also the relationship between pricing, unit production costs, and profitability in agricultural enterprises in Ukraine.

Researchers A. Ceglar *et al.* (2021) analysed the loss of land suitable for growing durum wheat in the future due to climate change, emphasising the significant impact of rising temperatures and changes in precipitation patterns on global agricultural markets. Similarly, the study by Y. Chai *et al.* (2022) considered risks associated with multiple pathogens affecting global wheat production and assessed likely economic losses and the need for investment in crop protection. In turn, M. Yanagi (2024) focused on the general challenges of wheat cultivation due to climate change and proposed adaptive strategies, including the improvement of agricultural technologies and the development of resistant varieties. All these studies confirm that grain production is highly dependent on climate change and associated risks, whereas the present study additionally considers the financial and economic aspects of Ukraine's grain market, in particular mechanisms for stabilisation under growing risks. This approach makes it possible not only to assess the threat of reduced cultivated areas and the impact of diseases but also to propose economic tools to minimise losses in this sector.

The study by A.C. Sánchez *et al.* (2022) is devoted to assessing the financial profitability of diversified agricultural systems at the global level. Using meta-analysis, the authors showed that such systems generally exhibit greater financial stability compared to monoculture farming, reduce crop loss risks, and improve resource use efficiency. At the same time, it was noted that profitability largely depends on regional characteristics, political conditions, and market

access. The current study also examines economic aspects of agriculture. Comparing approaches to assessing economic efficiency in various agrosystems enables a better understanding of the functioning of the grain market and the potential of diversification as a risk mitigation mechanism.

The study by G.B. de D. Ribeiro *et al.* (2024) focused on the use of financial instruments to assess the socio-economic sustainability of small-scale irrigated farming in Brazil. The authors analyse the financial profitability of agrosystems, viewing it as a key factor in the stability of agricultural enterprises. It is emphasised that effective financial planning and investment in technological solutions can enhance farm resilience to changes in the economic environment. The current study also examines financial aspects of agribusiness, particularly in the context of the grain market.

The work by S. Li *et al.* (2021) is dedicated to the life-cycle assessment and economic efficiency of maize cultivation practices in the western Corn Belt of the United States. The article analyses the impact of various farming methods on economic indicators and environmental sustainability, which correlates with the study of the financial and economic aspects of the grain market in Ukraine. Both studies highlight the need to optimise agricultural production through the implementation of effective financial and environmental approaches. The main difference lies in the fact that S. Li's study focuses on the evaluation of specific farming practices within one country, whereas the current study considers a broader financial and economic context of the grain market, including risks and regulatory mechanisms under current challenges.

The research by S.K. Kuchimov (2021) was focused on economic issues of ensuring the efficiency of agricultural production through the use of innovative technologies. The author emphasises the importance of technological development for increasing productivity and reducing costs in agriculture. In turn, the work by N. Davydenko *et al.* (2024) explores the modelling of innovation and investment development of agricultural enterprises in the context of ensuring their financial security. All three studies correlate with the present analysis of the

financial and economic aspects of the grain market, as they emphasise sustainability, efficiency, and innovation in the agricultural sector. The difference in the present study lies in its focus on macroeconomic risks and financial mechanisms for stabilising the grain market under current challenges.

In conclusion, the comparison of the financial and economic aspects of the grain market in Ukraine with current international and Ukrainian studies shows that the factors affecting pricing and the grain market have both commonalities and significant differences. In particular, the relevance of changes in the global grain market, price fluctuations, and the main factors determining supply and demand are noted both in foreign and Ukrainian studies. However, Ukraine has its own specific features in the form of the influence of national economic and political conditions.

The studies demonstrate that among the main factors determining grain pricing are seasonality, production volume fluctuations, natural factors, as well as the role of state policy, which is crucial for addressing economic problems. Additionally, international factors, particularly global grain market trends, play an important role for Ukraine. However, a number of issues still require more detailed analysis, especially regarding the interaction of financial and economic measures at local and international levels. In summary, it should be noted that despite the general similarity of the issues studied in the grain market, there are significant differences in economic aspects for Ukraine that require further study and adaptation to local realities.

CONCLUSIONS

As a result of the conducted research, the financial and economic indicators of three agricultural enterprises in Kharkiv Region with different forms of ownership were evaluated: PE "Agro", FE "Zerniatko", and LLC "Barvinok". The enterprises own or lease land plots with a total area of 1,307 ha, 703 ha, and 5,020 ha respectively, demonstrating the differences in the scale of their operations. According to the research data, the grain crop yields on the enterprises were as follows: wheat – 5.99 t/ha (PE "Agro"), maize – 6.20 t/ha (FE "Zerniatko"), barley –

3.58 t/ha (LLC “Barvinok”). These results indicate the competitive productivity of the cultivated crops in the region.

The analysis of financial indicators revealed varying levels of profitability depending on the crop and the enterprise. Thus, wheat cultivation at PE “Agro” resulted in a loss of 330 UAH/t, which is explained by high production costs. At the same time, maize and barley cultivation proved to be profitable, with results of 530 UAH/t and 220 UAH/t respectively. This highlights the need to optimise production processes to reduce wheat-related expenses. At FE “Zerniatko”, all crops were profitable, with maize generating the highest profit – 1,000 UAH/t. This was due to effective resource management, the use of modern technologies, and high yields. LLC “Barvinok” also demonstrated stable profitability. The best financial results were achieved in maize cultivation, with a profit of 850 UAH/t. The enterprise’s efficiency was driven by improvements in technological processes and increased mechanisation, which enabled the optimisation of production costs and ensured profitability across all cultivated crops.

Thus, the conducted research allows drawing several important conclusions regarding the financial and economic activity of agribusiness enterprises in Kharkiv Region. Data analysis confirmed that production efficiency and profitability directly depend on the level of enterprise specialisation, cost and technological optimisation, as well as the chosen management strategy. The findings confirm that cost optimisation, the selection of economically efficient crops, the proper use of land resources, and the development of modern technologies are key factors in the stable functioning of agricultural business under current economic challenges. Future research should focus on a more in-depth analysis of the financial structure of expenses, the impact of climatic factors, and market fluctuations in order to improve the efficiency of the sector’s enterprises.

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CONFLICT OF INTEREST

None.

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Ринок зернових в Україні: фінансово-економічні аспекти

Анотація. Дослідження було спрямоване на аналіз фінансово-економічних показників діяльності аграрних підприємств Харківської області з акцентом на розрахунок витрат

на одиницю продукції та виявлення особливостей функціонування зернового сектору. Методологія включала аналіз даних трьох підприємств різних організаційно-правових форм: приватного підприємства «Агро», фермерського господарства «Зернятко» та товариства з обмеженою відповідальністю «Барвінок». Для кожного з них було розраховано витрати на одиницю продукції за трьома основними культурами: пшениця, кукурудза та ячмінь. У результаті дослідження встановлено, що приватне підприємство «Агро» зазнало збитків у вирощуванні пшениці через високі витрати, які перевищували ринкову ціну, що свідчить про необхідність оптимізації агротехнологій. Водночас фермерське господарство «Зернятко» продемонструвало стабільні фінансові результати завдяки диверсифікованій структурі доходів, що зменшило ризики ринкових коливань. Товариство з обмеженою відповідальністю "Барвінок" отримало найбільший прибуток на одиницю продукції за рахунок спеціалізації на вирощуванні ячменю та сприятливих ґрунтових умов, однак вузька спеціалізація підвищує ризики в умовах зміни ринкової кон'юнктури. Для кукурудзи на найбільш прибутковому підприємстві рентабельність становила 1000 гривень за тонну, тоді як для ячменю – 850 гривень за тонну. Аналіз структури доходів показав, що диверсифіковані підприємства більш стійкі до коливань ринку, тоді як висока концентрація на одній культурі, як у разі з підприємством, що зосереджується на ячмені, створює додаткові ризики. На основі аналізу встановлено, що рівень фінансової ефективності підприємств залежить від їхньої спеціалізації, розміру земельного банку та рівня технологічного розвитку. Виявлено, що підприємства з більш збалансованою структурою виробництва краще адаптуються до ринкових змін, тоді як орієнтація на одну культуру може як підвищувати прибутковість, так і створювати додаткові ризики. Отримані дані дозволили оцінити економічну ефективність діяльності кожного підприємства. Результати дослідження сприяють ухваленню ефективних управлінських рішень для мінімізації ризиків у зерновому секторі України

Ключові слова: землекористування; зернові культури; аграрний ринок; фінансування; фінансові результати; агробізнес; ризики



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Formation of a strategy to increase the efficiency of agricultural enterprises

Abstract. The article was aimed at developing scientifically sound recommendations for improving the strategic management of agrarian enterprises to increase the efficiency and competitiveness. The article used the methods of system analysis, SWOT analysis, and statistical and economic methods to assess the status and prospects of development of agricultural enterprises. It examined the dynamics of changes in the structure of agricultural production by

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categories of producers in 2019-2023, analysed the impact of military operations on the exports of major crops, and summarised the main losses of the agro-industrial complex. It was established that despite significant infrastructure destruction and disruption of supply chains, the Ukrainian agricultural sector demonstrated high resilience and adaptability. Particular attention was paid to the role of various forms of management, in particular large agricultural enterprises and farms, in ensuring the stability of production. Data on the share of exports of grain crops and industrial crops were provided, and changes in the structure of sown areas reflecting the transformational processes in the agricultural sector during the war were considered. It was determined that the low level of digitalisation, the shortage of qualified personnel, and insufficient state support were the main factors limiting the efficiency of agricultural production. The analysis confirmed that these problems led to a decrease in productivity, limited adaptation to modern technologies, and low competitiveness of agricultural enterprises. It was found that the creation of a comprehensive agricultural hub, which combined educational, technological, and practical components, could significantly improve the level of staffing. A model of personnel management through the introduction of a system of continuous learning, the use of digital technologies, and personalised development plans was proposed. The necessity of close cooperation of agricultural enterprises with the Ministry of Digital Transformation and the Ministry of Agrarian Policy to provide state support and create a regulatory framework for the operation of such a hub was substantiated. The obtained scientific and practical results could be used as a basis for developing strategic decisions aimed at developing the agricultural sector in the context of post-war reconstruction and adaptation to modern economic challenges

Keywords: productivity; competitiveness; use of digital technologies; state support; development of human resources

INTRODUCTION

The relevance of the study is due to the important role of the agricultural sector in Ukraine's economy and the need to increase its efficiency in the context of globalisation and integration into the world market. The agricultural sector is strategically important for the country and is one of the main sources of foreign exchange earnings through the export of agricultural products. Despite its considerable potential, the efficiency of agricultural enterprises remains insufficient due to numerous economic, technological and social problems, which requires a comprehensive approach to the solution.

The scientific literature actively discusses the issue of increasing the efficiency of agricultural production, in particular through the prism of human resources, the level of digitalisation and state support. These factors are crucial for ensuring the competitiveness of the agricultural sector at both the national and international levels. Ukraine's agricultural sector, with its significant potential, needs to be modernised, which involves not only technological improvements but also changes in approaches

to education, training, and the integration of the latest technologies.

One of the areas that is gaining popularity is the strategic formation of agricultural clusters. The study by M.W. Sitnicki *et al.* (2024) focused on agrarian clusters as an important tool for increasing Ukraine's global competitiveness in the world market. The creation of such clusters allows optimising production processes, reducing costs and strengthening cooperation between different stages of agricultural production. It is important to note, however, that while the role of agricultural clusters in strategic development is undeniable, the issue of forming integrated educational and technological hubs for training in Ukraine remains under-researched. This issue requires special attention, since it is through such hubs that the educational process can be combined with modern technological advances, which is necessary for the professional development of agricultural workers.

Another important aspect that needs to be studied is the synergy between educational, research and production structures. L. Simkiv *et*

al. (2021) analysed the dynamics of structural changes in the agricultural sector in the context of sustainable development. The authors emphasised the importance of integrating these structures to ensure the sustainable development of the agricultural sector. However, the work did not pay enough attention to the practical aspects of integrating new technologies into the training system. Technological innovations, such as automation, data management systems and robotics, should become an integral part of the educational process in order to ensure that agricultural workers are qualified in the context of digital transformation.

Authors V. Baidala & A. Solop (2023) studied in detail the employment problems in the agricultural sector of Ukraine, focusing on the low level of labour force qualifications as a major barrier to productivity growth. The researchers note that most agricultural workers do not have up-to-date professional skills, which affects production efficiency and the ability of agricultural enterprises to compete on international markets. Low staff qualifications, in particular in the context of the latest technologies, mean that agricultural enterprises often do not use all the opportunities to optimise production processes and reduce costs. This underscores the need for a systematic approach to training and professional development, which should become an important component of agricultural policy.

In the research, O. Zakharchuk *et al.* (2021) focused on the modernisation of the material and technical base of agricultural enterprises, emphasising that without updating technical equipment, production will not be able to move to a new level of efficiency. However, the work does not sufficiently address the issue of digitalisation as a tool for increasing the efficiency of agricultural production. Digital technologies, such as yield monitoring systems, automation of production processes and the use of big data for forecasting, can significantly improve the efficiency of agricultural enterprises. The use of such technologies can not only optimise production processes, but also provide access to global markets and increase the competitiveness of products. Therefore, digitalisation should become an important component of the agricultural sector's modernisation strategy.

Researchers H. Zapsha & V. Sedov (2024) focused on the training of highly qualified personnel in the context of modern transformations, emphasising the need to adapt educational programmes to the rapidly changing needs of the labour market. The authors note that modern educational programmes for farmers should be flexible and focused on the current requirements of employers. However, the work does not contain a comprehensive approach to creating learning platforms that use the latest technologies, such as Virtual Reality (VR) simulators, to model real-life situations in the agricultural sector. The use of VR simulators allows creating interactive learning environments where students can practise the skills required to work in the agricultural sector without the need to directly participate in real production processes. These innovative teaching methods allow personalising the educational process by creating individual development plans for each student that meet the needs and interests. M. Nehrey *et al.* (2022) analysed the impact of the hostilities on the agricultural sector of Ukraine, drawing attention to the shortage of human resources and the destruction of supply chains, but the research does not offer specific mechanisms to overcome these problems. V. Sapych (2024) analysed the problems of financial support for agricultural business, while the issues of investment in human resources and educational infrastructure remain insufficiently covered.

The purpose of the article was to substantiate scientific and methodological approaches and develop practical recommendations for the formation of an effective strategy to improve the performance of agricultural enterprises in Ukraine in the context of current economic and social challenges. To achieve this goal, the article sets the following objectives: to analyse the current state and main problems of functioning of agricultural enterprises; to study the impact of state support, technological development and the level of staffing on the efficiency of agricultural production; to develop recommendations for improving the strategic management of agricultural enterprises in order to increase the productivity and competitiveness.

MATERIALS AND METHODS

The study analysed data for the period from 2019 to May 2024. The main sources of information used were official statistics from the State Statistics Service of Ukraine (Crop production 2023, n.d.; Area, gross harvest..., n.d.), reports from the National Institute for Strategic Studies (Ukraine's agricultural sector in 2023..., 2024), reports from the Ministry of Agrarian Policy and Food (Report on recipients..., 2021), a report by the NGO Ecodia (Rykovska *et al.*, 2024), as well as regulatory acts, in particular Law of Ukraine No. 1877-IV (2004), and the Tax Code of Ukraine No. 2755 (2010).

In the course of the study, the economic and statistical method was applied, which provided an opportunity to conduct a comprehensive analysis of the agricultural sector based on a quantitative assessment of key indicators. In particular, the volume of gross production of major crops was studied, which allowed the researchers to trace the dynamics of changes in production processes. A structural analysis of the distribution of agricultural products by different groups of producers was carried out, which made it possible to assess the contribution of each category (large enterprises, small farms, private households) to total production. An important part of the study was an assessment of the level of compliance with the statutory rate of state support for the agricultural sector, which was 1% of GDP. To increase the visibility and informativeness of the results, a graphical method was used. The construction of charts, graphs, and diagrams made it possible to visualise trends in the key performance indicators of agricultural enterprises, which, in turn, contributed to a better understanding of the effectiveness of various strategic approaches to the development of the agricultural sector.

One of the key methods was SWOT analysis, which was used to study the impact of digitalisation on the transformation of labour processes in agricultural enterprises. This method helped identify the strengths and weaknesses of digital technologies, including automated management systems, electronic document management, production process monitoring systems, and the use of digital platforms for coordination. In addition, the SWOT analysis helped identify

opportunities offered by digitalisation, including increased labour productivity, reduced operating costs, optimisation of production processes through the introduction of innovative solutions, and expansion of sales markets through digital platforms and marketplaces. At the same time, the study identified threats related to the insufficient level of digital literacy of staff, high costs of implementing new technologies, cybersecurity risks, and instability of technological solutions due to the rapid development of the digital tools market, which required regular updates and adaptation. The study used modern information technologies, in particular, Microsoft Excel (n.d.) statistical analysis software, which ensured high accuracy and visibility of data processing.

RESULTS

Analysis of the current state of the Ukrainian agricultural sector

Ukraine's agricultural sector plays a key role in supplying both the domestic market with food and building the country's active position on international agri-food markets. Thanks to its well-developed infrastructure and traditionally strong food exports, Ukraine was one of the five largest grain exporters in the world before the full-scale war, accounting for around 10% of global wheat exports, over 14% of corn and over 47% of sunflower oil. More than three-quarters of the production was exported, while domestic consumption of grain was only 20-25% (Karmadonova, 2023). Despite the hostilities that began in February 2022, Ukraine, thanks to the support of its international partners, remains a significant player in the global agricultural market. In 2023, the country exported 16.7 million tonnes of wheat to 67 countries, 28.1 million tonnes of corn to 78 countries, and 6.3 million tonnes of sunflower oil to 126 countries (Crop production 2023, n.d.). These indicators demonstrate the resilience and adaptability of the Ukrainian agricultural sector, despite significant losses and difficult operating conditions.

However, the large-scale aggression of the Russian Federation has caused a serious deterioration in Ukraine's food security. Disrupted supply chains, destroyed infrastructure, reduced planted areas and reduced production at operating enterprises have resulted in

significant direct and indirect losses. Rural households in Ukraine have also suffered serious losses. The losses amount to about USD 2.25 billion. Of this, USD 1.26 billion was lost in crop production and USD 0.98 billion in livestock production. Due to the war, 25% of agricultural households have stopped or significantly reduced

production, and in the frontline regions this figure reached 38% (Solop, 2024). The structure of Ukraine's agricultural sector includes a variety of business forms. Based on the data presented in Figure 1, it is possible to trace the dynamics of changes in the structure of agricultural production by producer category in 2019-2023.

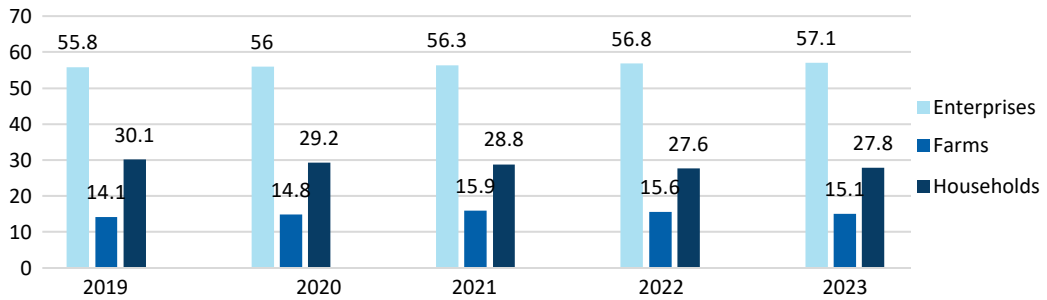


Figure 1. Structural distribution of agricultural production by producer groups, %

Source: compiled by the author based on Area, gross harvest... (n.d.), O. Rykovska et al. (2024)

Enterprises have consistently remained the main producers of agricultural products, demonstrating a gradual increase in the share of total production: from 55.8% in 2019 to 57.1% in 2023. This is evidence of the increased efficiency of large agricultural enterprises, the technological equipment and the ability to ensure stable production volumes even in a difficult economic environment. It is important to note that the growth rate, although slow, is stable, indicating positive trends in the development of this segment. Farms also play an important role in agricultural production, although the share is subject to some fluctuations. While in 2019, the share was 14.1%, in 2021 it reached 15.9%, and in 2023 it declined to 15.1%. This may indicate that farms are adapting to market conditions and gradually increasing the production capacity, despite the challenges of limited resources and access to finance.

The share of households in the production structure shows a steady downward trend: from 30.1% in 2019 to 27.8% in 2023. This indicates a gradual transformation of the agricultural sector, where small private farms are losing ground to larger producers. The decline in the share of household farms may be due to both a decline in production and labour migration to other areas

of activity. The polarisation of small and large producers is the result of state agricultural policy. Small farms are oriented towards self-sufficiency and local markets, using labour-intensive production methods and low levels of mechanisation. These farms account for a significant share of milk (78.3%), vegetables (89.3%) and potatoes (99.1%). In contrast, large agricultural enterprises specialise in the production of commercially attractive crops and industrial products, such as chicken (70.3%) and pork (25.1%) (Rykovska, 2024).

Agricultural enterprises are crucial for the crop sector, producing the main export-oriented crops – wheat, corn, sunflower, rapeseed, and soybeans. The high level of ploughed land (over 90%) and the emphasis on monoculture cultivation have led to a reduction in crop diversity and soil depletion. In the pre-war period, the sown areas of agricultural enterprises were focused on cereals and legumes (58.2 per cent) and industrial crops (39.1 per cent), while households focused on growing vegetables (21.4 per cent) and fodder crops (13.3 per cent) (Rykovska, 2024). The dynamics of gross production of major crops in 2020-2023 clearly demonstrates the impact of hostilities and economic conditions on the crop sector (Table 1).

Table 1. Changes in gross production volumes of major agricultural crops in Ukraine

		2019	2020	2021	2022	2023	Deviation of 2023 to 2019	
							+/-	%
Gross production of main agricultural crops, thousand tons								
Grain and legume crops	wheat	24,234.1	24,877.4	22,654.2	20,729.2	21,625.2	-2,608.9	-10.8
	barley	6,276.5	7,636.3	6,396.2	5,608.2	5,507.2	-769.3	-12.3
	corn	29,590.1	30,290.3	29,523.1	26,186.9	31,030.4	+1,440.3	+4.9
Technical crops	soy	29,467.8	2,797.7	3,178.6	3,443.8	4,742.6	-24,725.2	-83.9
	rapeseed	2,867.1	2,492.0	2,867.0	3,250.3	4,183.7	+1,316.6	+45.9
	sunflower	13,649.1	13,110.4	12,671.1	11,328.7	12,759.7	-889.4	-6.5
	sugar beet	9,126.9	9,150.2	9,734.9	9,941.5	9,873.2	+746.3	+8.2

Source: compiled by the authors based on Crop production 2023 (n.d.), O. Rykovska et al. (2024)

In the grain and pulses segment, there was a general decline in production of the main types of grain. In particular, gross wheat production in 2023 decreased by 10.8% compared to 2019, which is a decrease of 2,608.9 thousand tonnes. A similar trend is typical for barley – its production decreased by 12.3% (-769.3 thousand tonnes). At the same time, corn is showing steady growth: in 2023, its gross production increased by 4.9% (+1,440.3 thousand tonnes) compared to 2019. This may indicate that this crop is more adaptable to changing climatic and economic conditions. As for industrial crops, the situation is more ambiguous. Soybeans showed the sharpest decline, with its production down 83.9% in 2023 (-24,725.2 thousand tonnes), which may indicate significant difficulties in growing or lower demand. Rapeseed in 2023 showed an increase in production volumes compared to 2019 (from 2,867.1 to 4,183.7 thousand tonnes), which is an increase of 1,316.6 thousand tonnes or almost +46%. This may indicate an increase in demand for rapeseed from the European market or more favourable price conditions. At the same time, sunflower production decreased by 6.5% (-889.4 thousand tonnes), this crop remains an important component of agricultural exports. A positive trend is the increase in sugar beet production: in 2023, its gross harvest increased by 8.2% (+746.3 thousand tonnes) compared to 2019. This may indicate an increase in the efficiency of growing this crop and improvement of technological processes.

The full-scale invasion of Russia in 2022 had a significant impact on Ukraine's agricultural sector, causing a number of negative

consequences for both crop production and foreign trade. The reduction in crop acreage was one of the most significant consequences: in 2022, the area of agricultural land decreased by 21%. In 2022-2023, about 5.4% of the areas previously used for crop production were returned to Ukrainian control, but in 2024, about 15% remain under temporary occupation, which significantly limits production capacity (Bogonos et al., 2024). In addition to the reduction in acreage, the war has led to serious logistical and resource problems. In particular, the difficult access to fertilisers and fuel has led to a decline in yields of the main export-oriented crops – wheat, corn, sunflower, rapeseed, and soybeans. Ongoing hostilities, shelling, and the destruction of infrastructure created additional challenges for agricultural operations. Production also continued to decline due to labour shortages caused by mobilisation and forced migration (Ukraine's agricultural sector in 2023..., 2024).

A significant share of Ukraine's grain and oilseed harvest has traditionally been exported, accounting for more than two-thirds of foreign trade revenues. The war has significantly hampered export operations: the blockade of seaports has led to a sharp decline in the volume of agricultural exports. Although the signing of the Grain Agreement and the creation of a private 'grain corridor' have partially restored export flows, high logistics costs continue to have a negative impact on domestic prices. This prevents farmers from fully benefiting from existing export routes and threatens the financial stability of agricultural enterprises.

The international sanctions imposed on Russia due to the geopolitical situation have led to significant changes in the geography of Ukrainian agricultural exports. During the war, there were changes in the directions of supply of food and other agricultural products. In particular, against the backdrop of a decline in the value of exports, the European Union became the largest market for Ukrainian products. The EU's share of total agricultural exports increased from 28% in 2021 to 57% in 2024. This opens up new opportunities for Ukrainian farmers, who were able to occupy the vacant niches left by countries that used to supply finished products to Russia (Bobrovtskyi *et al.*, 2024). At the same time, Ukraine did not stay away from the search for alternative markets. China, which was one of the main partners, reduced its share in Ukrainian exports from 15% in 2021 to 10% in 2024. On the other hand, the Turkish market increased its share from 5% to 9%. At the same time, the share of Ukrainian products in the markets of Asia (excluding China and Turkey) and Africa has significantly decreased (Karmadonova, 2023).

Ensuring food security under martial law requires comprehensive state support for the agricultural sector, which is especially important in the context of preparing and conducting the 2025 sowing campaign. In this regard, the key role is played by effective management of sown areas, provision of necessary resources and adaptation to the current challenges of the global and domestic markets. According to the official forecasts of the Ministry of Agrarian Policy and Food of Ukraine, in 2025 the total area under crops in Ukraine will exceed 23 million hectares (Sown area in 2025..., 2024). Of these, 11,067 thousand hectares are allocated for grain crops, which is 48.1% of the total sown area. Spring crops occupy a significant part of the area – 5,825.5 thousand hectares, with the largest areas allocated for corn (4,145.5 thousand hectares), spring barley (790.2 thousand hectares), spring wheat (222.7 thousand hectares), peas (216.5 thousand hectares), oats (161.6 thousand hectares), buckwheat (86.8 thousand hectares) and millet (85.5 thousand hectares). Winter crops cover an area of 5,241.5 thousand hectares.

On the other hand, the area under corn is expected to increase, driven by increased trade

in this crop and improved logistics capabilities due to the stable operation of Odesa ports. High corn yields and expanding export opportunities will help to improve the economic efficiency of this area of agricultural production. In summary, the current state of Ukraine's agricultural sector is characterised by a significant dependence on export-oriented crops, polarisation between small and large producers, and serious challenges posed by the ongoing hostilities and the destruction of infrastructure. Nevertheless, the sector has demonstrated resilience and the ability to adapt to new conditions thanks to international support and a commitment to maintaining its position in the global agri-food market.

The impact of state support on the efficiency of agricultural production

In the modern environment of economic transformation and growing globalisation, which is guided by the principles of sustainable development, one of the key areas of Ukraine's economic policy is the modernisation of the agricultural sector. This approach ensures an effective transition to an innovative business model based on high-tech solutions and improved human resources. One of the main obstacles to improving the efficiency of agricultural enterprises in Ukraine is the insufficient level of technological support. Only 30% of these enterprises implement modern digital tools, including precision farming systems, drones, and analytical platforms (How to start implementing precision farming..., n.d.). This limits the possibilities for optimising production processes and increasing productivity. In addition, limited access to financial resources is becoming a serious obstacle for many small and medium-sized agricultural enterprises, which face difficulties in attracting investment and credit due to high interest rates and insufficient state support (Assessment of the impact of war..., 2024).

Long-term extensive use of land resources in Ukraine has led to soil depletion, reduced productivity of agricultural land and a growing need for intensive production methods. The introduction of modern technologies, such as precision farming, automated crop monitoring systems, drones and Global Positioning System (GPS), is a prerequisite for increasing the efficiency of

agricultural production. It also helps to minimise the negative impact on the environment and ensure food security (Herrero *et al.*, 2020).

An important aspect of modernisation is the adaptation of the agricultural sector to climate change and global trends in the sustainable use of natural resources (Gras & Cáceres, 2020). The intensive use of land resources without proper restoration measures leads to a decrease in soil fertility and deterioration of the ecological state of agricultural landscapes. The situation has been greatly complicated by the effects of hostilities and landmines: in 2022, about 30% of agricultural land, or approximately 5 million hectares, became unsuitable for sowing. In 2023, this figure decreased, but still remained significant, with up to 25% of the area inaccessible for cultivation (Karmadonova, 2023). An additional blow to land resources and the agricultural sector was the destruction of the Kakhovka hydroelectric power station, which caused large-scale environmental impacts and made it difficult to irrigate large areas critical for agriculture.

The war caused significant economic losses to Ukraine's agricultural sector, resulting in the destruction of infrastructure and a significant decline in production. The total value of destroyed assets is estimated at USD 10.3 billion, with the largest losses recorded in the agricultural machinery segment, with damage and destruction of USD 5.8 billion, accounting for 56.7% of the total losses. In addition to material losses,

a significant economic impact was caused by lost revenues of agricultural producers and increased production costs, which are estimated at USD 69.8 billion. In particular, the decline in crop production resulted in losses of USD 35.1 billion, and in livestock production – USD 5.6 billion. The impact on market prices was also significant: the decline in domestic prices resulted in additional losses of USD 24.1 billion, while the increase in production costs the agricultural sector USD 4.4 billion (Neyter *et al.*, 2024).

To ensure the effective development of the agricultural sector, active state support for innovation is needed. This involves stimulating research, creating favourable conditions for attracting investment in technological upgrades, and developing mechanisms for financing training and retraining programmes. Financial support for the agricultural sector is an important instrument of state protectionism aimed at stimulating innovation, increasing the competitiveness of agricultural products and ensuring food security. In Ukraine, the level of this support depends largely on the legislative framework and the financial capacity of the state. According to the Law of Ukraine No. 1877-IV (2004), the annual amount of funds allocated to support agricultural producers should have been at least 1% of agricultural output. However, the actual amount of funding remained below the established norms, which hindered the development of the sector (Fig. 2).

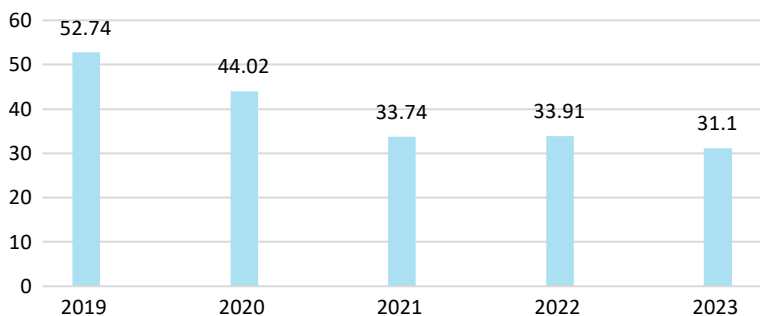


Figure 2. Implementation of the legally established support rate (1%) for the agricultural sector, 2019–2023, %

Source: compiled by the authors based on Report on recipients ... (2021), O. Rykovska *et al.* (2024)

The analysis of the data in Figure 2 shows a change in the trend in the level of compliance

with the legislatively established norm of support for the agricultural sector in Ukraine in

2019-2023. In 2019, the level of support was 52.7%, but in 2020 it dropped to 44.0%, which indicates a decrease of 8.7 percentage points. In 2021-2023, further negative dynamics were observed: 33.74% in 2021, 33.9% in 2022, and a low of 31.1% in 2023. Nevertheless, the 2023 figure remains lower than in 2019, indicating a still insufficient level of financial support for the industry. In general, the level of compliance with the state support norms has experienced significant fluctuations over the analysed period, with a general downward trend (Rykovska, 2024).

One of the unimplemented legislative initiatives concerned amendments to the Law of Ukraine No. 1877-IV (2004), which were supposed to introduce new principles for the distribution of state aid. These changes were expected to help preserve the diversity of the agricultural sector and strengthen the country's food security. In particular, it was proposed to introduce the principles of equitable distribution of funding and its targeting. The principle of equity stipulated that state support should be distributed proportionally, with a limit on the maximum amount of support per recipient, which was supposed to prevent monopolisation of budget funds by large agricultural holdings. The principle of targeting was intended to provide priority funding to small producers, primarily family farms that own or use land plots of up to 100 hectares. However, the actual implementation of these provisions in the funding allocation mechanisms remained fragmented, and the declared support for small farms was not properly enshrined in the relevant regulations.

This approach has resulted in a significant imbalance in the distribution of state aid, which has had a negative impact on small and medium-sized agricultural enterprises. A large share of budgetary funds is traditionally allocated to large agricultural corporations and enterprises with expanded land holdings and significant financial turnover. According to the Report on Recipients of State Support in the Agricultural Sector (Report on recipients..., 2021), in 2019-2021, the total amount of state aid amounted to UAH 13.3 billion, which was distributed among almost 19 thousand agricultural producers. It is projected that in 2024, the agricultural sector will receive UAH 4.2 billion from the state budget

(Budget 2024..., 2023). The main recipients of these funds are large agricultural enterprises with a land bank of more than 1.000 hectares, as well as companies included in the register of large taxpayers. According to the Tax Code of Ukraine (Tax Code of Ukraine No. 2755, 2010), these are companies with annual revenues of more than EUR 50 million or total annual tax payments of more than EUR 1.5 million.

At the same time, small farms that cultivate land of up to 50 hectares remain outside the scope of effective support. The share in the total number of farms is 47.3%, but the amount of budgetary funds the farms receive is minimal. In 2019, the main form of support was the provision of subsidies for raising young cattle, which were used by almost 100,000 households. In 2020-2021, funding was refocused on the development of beekeeping, which allowed about 5,000 beekeepers to receive special subsidies for bee colonies annually. In 2024, these trends continued, as well as the expansion of support programmes for the cooperative movement aimed at uniting small farmers to increase the competitiveness (Rykovska, 2024).

However, these measures do not take into account the real needs of small producers, as there is virtually no differentiation of farms by the size of land holdings when distributing financial assistance. As a result, the main recipients of high-cost state funds are farmers specialising in the cultivation of high-margin grains, oilseeds and chicken production. At the same time, small farms engaged in labour-intensive types of agriculture, such as growing vegetables, fruits, berries and livestock products, remain virtually deprived of state support. This situation reinforces market monopolisation, reduces competition and hinders the sustainable development of the agricultural sector, which requires an immediate review of the mechanisms for allocating budget funds and ensuring that small and medium-sized producers are given real priority in the state support system.

State support for Ukraine's agricultural sector underwent significant changes in 2022 due to the outbreak of a full-scale war. Under martial law, there was an urgent need to adapt funding programmes to the new realities and challenges faced by agricultural producers. One of the

significant innovations was the introduction of mandatory registration of recipients in the State Agrarian Register (SAR) in August 2022, which made the process of distributing public funds more transparent and streamlined (Rykovska, 2024). The main financial instruments available to farmers in 2022-2024 include the “Affordable Loans 5-7-9%” programme. Under this programme, agricultural producers attracted UAH 33.8 billion, which was 15% of all loan agreements concluded. This programme enabled farmers to receive loans at preferential rates of 5%, 7% or 9% per annum depending on the size of the business, the number of jobs created and other criteria. Under this programme, farmers could receive a loan of up to UAH 60 million with a zero interest rate for six months, which later dropped to just 5%. In 2022-2024, the programme was expanded to include state compensation of the interest rate for enterprises engaged in growing crops, food production, and processing of agricultural products. For farmers, the “Affordable Loans 5-7-9%” programme has become a key tool for financing the sowing campaign, purchasing machinery, modernising production and providing liquidity. Thanks to the programme, farmers were able to attract cheaper credit resources, which is especially important in times of economic instability and rising production costs (Affordable loans 5-7-9% available, n.d.).

An important initiative was the government’s eRobota programme, launched in 2022, which provided grants for the establishment or development of horticulture, berry growing, viticulture and greenhouse farming. This programme was available to both legal entities, including farms, and individual entrepreneurs. One of the key conditions for receiving a grant was the creation of new jobs or the recruitment of new farm members, as well as 30% co-financing of projects. To receive a grant, applicants had to submit a business plan, pass a screening process to ensure compliance with the programme’s criteria, and ensure that the funds were used for the intended purpose. Since 2023, the programme has simplified the application procedure and expanded the areas of funding, including support for food production, agricultural processing, and the creation of

cooperatives (isWork, n.d.). The support programmes introduced in 2022-2024 have been highly effective in ensuring the financial stability of the agricultural sector. At the same time, there is still a need to improve the mechanisms for allocating funds so that small and medium-sized producers have equal access to finance alongside large agricultural holdings. An important step in this direction is the further development of the State Agrarian Register, which could become the basis for establishing fair and transparent conditions for the distribution of state aid in the Ukrainian agricultural sector.

Digitalisation processes open up new opportunities to improve the efficiency of agricultural business, but at the same time place high demands on the sector’s human resources. In the context of the Fourth Industrial Revolution, traditional approaches to human resources management and workforce development need to be significantly revised. Innovative technologies, such as precision farming systems, automated processes, drones and IoT devices, are changing not only the technological aspects of production but also creating new requirements for the professional competencies of agricultural workers. A modern specialist is expected not only to possess classical agronomic knowledge, but also to develop digital skills, the ability to work with big data, use specialised software, and make decisions based on analytics (Baidala & Solop, 2023).

In view of this, the problem of human resources readiness for digital transformation is becoming particularly relevant. The effective implementation of innovative technologies largely depends on the ability of staff to quickly adapt to changes and master new tools. In this context, studying the processes of transformation of the agricultural sector’s human resources potential becomes key to ensuring the competitiveness and sustainable development of agricultural production. The absence of systematic training and retraining of specialists in modern agricultural technologies significantly complicates the effective use of the latest equipment and innovative management methods. This problem is exacerbated by an acute shortage of labour in the agricultural sector. As a result of the armed conflict, a significant number of agricultural workers and farmers were forced

not only to cease the activities but also to leave the places of residence. According to the Food and Agriculture Organisation of the United Nations, more than 150,000 people employed in the food system have suffered direct losses or been forced to migrate (Ukraine's agricultural sector in 2023..., 2024).

Thus, there is a need to formulate strategies for the development of agricultural enterprises that take into account both technological changes and increased requirements for

professional training. An integrated approach to human resource development in the context of digitalisation will help to improve the efficiency of production processes and ensure sustainable growth of the agricultural sector in the long term. The SWOT analysis shows that digitalisation has significant potential to transform labour processes at agricultural enterprises, but its successful implementation requires careful planning, financial investment and technological readiness (Table 2)

Table 2. SWOT analysis of the impact of digitalisation on the transformation of labour processes in agricultural enterprises

Strengths	Weaknesses
Increasing productivity by automating production processes and using precision farming.	The high cost of implementing digital technologies and the need for significant investment.
Improving product quality by monitoring the health of crops and animals using IoT sensors and drones.	Insufficient level of digital literacy of staff and the need for specialised training.
Cost optimisation through accurate forecasting of crops and resources based on Big Data and artificial intelligence.	Dependence on a stable internet connection and technical support.
Increasing competitiveness through rapid adaptation to market changes.	Risk of technical failures and the need for regular software updates.
Opportunities	Threats
Opening up new markets through the use of online platforms to sell products.	Cyber threats related to the use of digital platforms and data management systems.
Improving logistics processes through digital supply tracking solutions.	Technological dependence and possible disruptions due to lack of technical support.
Implementation of smart contracts based on blockchain technologies for transparent and secure transactions.	Instability of legislative regulation on the digitalisation of the agricultural sector.
Developing precision farming to reduce costs and increase yields.	Staff resistance to change due to fear of job loss or the need for retraining.

Source: compiled by the authors based on D. Krasovskiy (2024)

To achieve maximum results, it is necessary to develop a strategy to minimise risks and take advantage of opportunities, building on the strengths of the enterprise. It is important to invest in staff training, cybersecurity and infrastructure development to create an efficient and sustainable digital ecosystem at agricultural enterprises. An analysis of the impact of state support, technological development, and the level of human resources on agricultural production efficiency shows that these points are closely interdependent and have a complex impact. State support, in particular through subsidies, tax privileges and grant programmes, creates the necessary conditions for modernising production processes and increasing the competitiveness of agricultural enterprises. At the same time, technological development, including the

introduction of digital solutions, automation and innovative agricultural technologies, contributes to increased productivity, cost optimisation and improved product quality.

Environmental challenges also have a significant impact, as intensive use of land resources without proper restoration measures leads to a decline in soil fertility and deterioration of the ecological state of agricultural landscapes. The situation has been significantly complicated by the effects of hostilities and landmines: in 2022, about 30% of agricultural land, or approximately 5 million hectares, became unsuitable for sowing. In 2023, this figure decreased, but still remained significant, with up to 25% of the area inaccessible for cultivation (Karmadonova, 2023). An additional blow to land resources and the agricultural sector was the destruction

of the Kakhovka hydroelectric power station, which caused large-scale environmental impacts and made it difficult to irrigate large areas critical to agriculture.

However, the realisation of these opportunities largely depends on the level of human resources. Highly skilled professionals capable of effectively using modern technologies and adapting innovations to specific production conditions are key to the success of the agricultural sector transformation. At the same time, the shortage of qualified personnel can be a significant barrier to the implementation of technological solutions and a decrease in production efficiency.

Thus, in order to achieve high efficiency in agricultural production, it is necessary to ensure a balanced and coordinated interaction between government initiatives, technological development and human resources policy. Only a comprehensive approach based on a long-term strategy and investments in human capital can guarantee the sustainable development and competitiveness of the agricultural sector in the face of global challenges.

Recommendations for improving the efficiency of strategic management of agricultural enterprises

Effective management of agricultural enterprises is a key factor in ensuring the productivity and competitiveness in the context of modern economic challenges and digitalisation. Given the problems identified in the previous section, including insufficient state support, slow technological development, and a shortage of qualified personnel, it is necessary to formulate comprehensive recommendations for improving management approaches. In this context, it is important to take into account not only the internal problems of agricultural enterprises, but also the impact of global trends and changes in international markets.

Firstly, digitalisation should be seen as one of the key tools for improving the efficiency of agricultural enterprises. The introduction of innovative technologies helps to optimise production processes, reduce costs and improve product quality. An example of successful implementation of digital solutions in the agricultural sector is AgroGloryTime. Its business

model is based on environmental principles and a commitment to sustainable development. The use of digital technologies in production allows the company to minimise the use of chemicals, increase the share of green mass and meet strict European environmental safety standards. By combining environmental, economic, and social approaches, AgroGloryTime creates a balanced agro-industrial system that serves as an example of effective innovation in the industry (AgroGloryTime, n.d.).

Secondly, for the effective recovery and development of Ukraine's agricultural sector in the post-war period, it is necessary to create effective mechanisms of interaction between agricultural enterprises and state institutions. A key aspect of the reforms should be to support small producers, who play an important socio-economic role in ensuring food security, rural employment and spatial development of the regions. The experience of EU countries shows that small farms require the most attention, as such farms often face difficulties in accessing financial resources. The introduction of simplified procedures for obtaining state support, subsidising modernisation and encouraging cooperation between small producers can be effective tools for increasing the productivity and competitiveness.

Third, the European experience of implementing the Common Agricultural Policy (CAP), which was introduced after the Treaty of Rome in 1959, should be taken into account. During 2000-2021, the CAP underwent numerous reforms due to both external pressure from trading partners and internal challenges, in particular the problem of excessive agricultural hoarding, which distorted the market and trade. As a result of these changes, the scale of such distortions has significantly decreased (Nivievskiy *et al.*, 2021).

The current CAP structure consists of two main pillars, often referred to as 'pillars'. The first pillar comprises market, trade and income support policies, focusing mainly on direct payments to farmers. These measures are funded exclusively at the EU level and are applied uniformly across all Member States. The main form of support is the basic payment, which is complemented by additional payments, such

as for the use of sustainable farming practices ('greening'), support for young farmers and special voluntary schemes that can be implemented at the national level. Many of these payments are independent of production volumes and are based on the area of land under cultivation or the number of livestock. Recipients of such support are required to comply with environmental, plant health and animal welfare standards, which ensures the sustainable development of the agricultural sector.

The second pillar of the CAP is aimed at rural development and is a joint responsibility of the EU and national governments. Within this pillar, each country chooses specific measures in line with the EU's overall policy framework, partially financed from its own budget. As a result, the nature and content of structural policies vary considerably between member states. The main measures of the second pillar are aimed at supporting small and medium-sized farming, including advisory services, producer group development programmes, financial assistance for business start-ups, product promotion, professional skills development and the development of rural cultural heritage. It also supports small farmers' markets, diversification of agricultural activities, and the development of rural tourism (Nivievskiy *et al.*, 2021).

Thus, the experience of EU countries in supporting small agricultural enterprises demonstrates the effectiveness of a comprehensive approach that combines financial incentives, advice, infrastructure development and compliance with environmental standards. This model can serve as a useful example for other countries seeking to create a sustainable and competitive agricultural system. In addition, it is necessary to take into account the specifics of the Ukrainian agricultural sector, where a significant part of production is provided by private farms. Given adequate financial support and assistance in formalising the activities, these producers could significantly increase the output, which would have a positive impact on the country's food security and export potential. Thus, a comprehensive approach to improving financial support and development of small producers will be an important step towards sustainable development of Ukraine's agricultural sector.

Fourth, it is necessary to provide state assistance to agricultural enterprises in passing international certification. This will help to increase the competitiveness of products, enter new markets and increase exports. The main functions of such institutions should be to coordinate the activities of enterprises, provide legal protection, and develop and implement policies aimed at developing modern agricultural infrastructure and supporting innovation.

Fifth, to address the problem of human resources in the agricultural sector, it is advisable to create a comprehensive agricultural hub that would transform approaches to human resources management. Such an innovative mechanism not only accumulates modern educational technologies, but also promotes the systemic development of professional qualities of agricultural specialists (Krasovskiy, 2024). In the modern environment of economic instability and constant external challenges, it is important to create a flexible human resource management system. The main goal of the agrarian hub is to create a dynamic ecosystem of continuous learning and professional development that combines educational, technological and practical components. This approach will not only eliminate the shortage of qualified personnel but also ensure rapid adaptation to technological transformations.

Implementation of the project requires close cooperation between government agencies, including the Ministry of Digital Transformation of Ukraine and the Ministry of Agrarian Policy and Food. This will help ensure state support and legitimacy of the educational platform, as well as attract methodological support and partial funding. The functional structure of the hub includes several modules: a competency assessment unit, an educational platform, and a mentoring support system. Innovative diagnostic techniques, digital testing and VR simulators will enable a comprehensive assessment of theoretical knowledge and practical skills of specialists. Special attention is paid to the development of soft skills through case studies and situational tasks.

The learning platform is based on the principles of personalisation, accessibility and advanced development. It offers a wide range of online courses on precision farming, smart greenhouse management, digital systems and

innovative agricultural technologies. Interactive materials, video tutorials and practical cases facilitate in-depth learning. Individual development plans based on gap analysis are created for employees' professional growth, integrating a personal progress tracker and a mentoring support system. An important advantage is the hub's seamless integration with leading enterprise management systems, which allows for automatic updating of competency requirements when new technologies are introduced. Thus, the creation of a comprehensive agricultural hub is a strategic initiative that can systematically address the problems of human resources in the agricultural sector. It ensures flexibility, innovation, and a high level of training, meeting the current needs of the modern agricultural market.

DISCUSSION

The results of the study indicate a significant impact of three main factors on increasing production efficiency in the agricultural sector: state support, human resources and technological innovations. The analysis confirmed that the introduction of digital solutions and adaptation strategies not only helps to optimise the use of resources, but also directly correlates with increased productivity in agriculture. These findings were confirmed in the works of S. Auci & N. Barbieri (2020), who drew attention to the importance of innovation in the processes of climate change adaptation and improving the technical efficiency of agriculture in Europe. The authors note that innovative technologies allow not only to maintain but also to increase productivity in the face of climate change, which is consistent with the findings of this study on the importance of technological innovation for the agricultural sector.

In turn, the comparison of the results obtained with the works of A. Hajiyeva *et al.* (2024) revealed similar trends in the impact of technological innovation on productivity, in particular in post-Soviet countries. The study also examined numerous opportunities for the introduction of digital and technological solutions that could have a positive impact on the agricultural sector, but the authors note that the introduction of innovations does not always go smoothly due to socio-economic and infrastructural

problems, especially in countries undergoing transformation. At the same time, some aspects of the study by C. Gras & D. Cáceres (2020), which focused on the problems of capitalising natural resources, partially contradict the positive dynamics of innovation in this study. The authors point out that even with technological advances, there are limitations on the use of natural resources, which can reduce production efficiency, especially in countries where natural resources cannot be properly monetised or used efficiently.

The importance of adaptation strategies in the context of global challenges, in particular climate change, is also emphasised in the works of A. Getahun & D. Milkias (2021), who analysed the efficiency of agricultural systems in Ethiopia. These authors emphasised that in order to support the sustainable development of the agricultural sector, it is necessary to constantly adapt farming practices to new climatic conditions. The researchers emphasised that success in agriculture depends on networking and close cooperation between different stakeholders. In turn, the study results showed that while cluster approaches may be appropriate in some cases, it is the integration of digital technologies that is more important for increasing efficiency, as these technologies reduce production costs, facilitate management processes and increase productivity at all stages of the agricultural cycle.

Similar approaches to increasing the resilience of the agricultural sector were also proposed in the study by M. Lacoste *et al.* (2022), which focused on the implementation of experimental practices at the farm level, which can significantly increase resilience to adverse climatic conditions. This approach is based on the principles of adaptive management and includes a set of measures that may vary depending on regional characteristics, type of agricultural activity and available resources. An important aspect considered in the study by M. Lacoste *et al.* is the role of local farmers' initiatives in increasing the adaptability of the agricultural sector. The involvement of farmers in the development and testing of new approaches allows not only to take into account the specifics of particular farms, but also promotes the effective dissemination of successful practices among other producers. Thus, a kind of adaptive knowledge exchange

network is formed, which increases the overall capacity of the agricultural sector to respond to the challenges of climate change.

The study by B.A. Magesa *et al.* (2023) emphasised the importance of choosing adaptation strategies in response to climate change, which is fully consistent with the results of this study, which emphasises the need for a flexible approach to managing production processes. In response to changes in the environment, farmers should be able to quickly adapt the strategies to minimise the negative impact of climate factors on yields and productivity. On the other hand, the experience of P. Priyadarshini & P.C. Abhilaash (2021) demonstrated the effectiveness of policy recommendations aimed at strengthening the resilience of agri-food systems. This study confirmed that support from governments in the form of policy measures, funding for innovation and infrastructure development can significantly enhance the effectiveness of adaptation strategies and ensure the resilience of the agricultural sector to global challenges.

The findings of this study correlate with the conclusions of international experts on the need to introduce innovations for an accelerated transition to sustainable food systems. In particular, M. Herrero *et al.* (2020) emphasised that innovative solutions in the agricultural sector are a key tool for transforming traditional production methods into more efficient and environmentally responsible models. The study focused on a comprehensive analysis of the factors that affect the sustainability of food systems on a global scale, including the impact of technological development, government policies, and changes in consumer behaviour. Comparison with the study by M. Herrero *et al.* (2020) allowed concluding that the global trend towards accelerating the transition to sustainable food systems through innovation is not only theoretically sound but also supported by empirical data. Innovative technologies, digitalisation, adaptive governance models, and changes in policy and consumer behaviour form a comprehensive approach that can ensure the long-term stability and efficiency of the agricultural sector.

The impact of digitalisation on agriculture has also been considered in S. Rolandi *et al.* (2021) and X. Zhang & D. Fan (2024), which

emphasise the importance of digital transformation for increasing farmers' incomes. The study showed that in the context of the digitalisation of the agricultural sector, there is an increase in adaptability to changes in the market environment. In the context of the digitalisation of the agricultural sector, the study by A. Tandon *et al.* (2020), which focused on the introduction of innovative technologies to optimise processes in agriculture. The authors emphasise that digital solutions, such as the use of sensors, unmanned aerial vehicles (drones), and big data analysis, can significantly increase the efficiency of agricultural production, reduce costs, and ensure sustainable development. Most importantly, technology can improve water management, which is critical in regions with limited access to water. A. Tandon *et al.* also noted that the full implementation of digital technologies requires a change in approaches to training and skills development among farmers, which is a barrier to widespread adoption of technologies at the local level. However, overall, the study demonstrates how digitalisation can stimulate economic development and increase the competitiveness of the agricultural sector.

The results of the study are comparable to the findings of M. Kernecker *et al.* (2021), who emphasised the importance of the role of stakeholders in the implementation of digital agricultural innovations. The study emphasised the need to involve all participants in the agricultural chain, from farmers to government agencies, to ensure the successful integration of digital technologies. However, the results show that, along with stakeholder engagement, the most important factor is the effective integration of digital technologies into agricultural production. This ensures more significant and rapid changes in efficiency and productivity than traditional methods of cooperation based on cluster approaches.

A comparative analysis of studies conducted in other countries demonstrates the importance of a comprehensive approach to modernising the agricultural sector. For example, M. Schmink (2020) describes the Brazilian experience of transforming the country into a modern agrarian economy, focusing on the active introduction of innovative technologies that

have become the basis for increasing competitiveness in international markets. On the other hand, J.-H. Zhou *et al.* (2020) investigated the sustainability of vegetable production in China in the context of the COVID-19 pandemic, highlighting the importance of rapidly adapting technological processes to new conditions. This emphasises the need for rapid adaptation and readiness for change to ensure the sustainable development of the agricultural sector, which is fully consistent with the findings of this study.

No less important is the study by V. Câmpăneanu (2022), which focused on the global food crisis caused by the war in Ukraine. The author emphasised that technological solutions can be an important factor in ensuring food security, as these solutions can significantly increase production efficiency and ensure the sustainability of the agricultural sector even in crisis conditions. This also correlates with the results that indicate that innovative technologies can significantly improve the economic sustainability of agricultural enterprises in the context of global challenges.

The study by A. Raihan *et al.* (2022) examined the relationship between technological innovation, economic growth, and environmental sustainability. This is an important aspect for the modernisation of the agricultural sector, as increased technological efficiency must be combined with the pursuit of environmental sustainability to avoid negative environmental impacts. The use of the latest technologies to optimise irrigation, pesticide and herbicide use, as noted by T. Talaviya *et al.* (2020), also confirms the effectiveness of innovation in reducing costs and increasing productivity. In addition, the study by D. Rose *et al.* (2021) emphasised the importance of taking into account social, economic and environmental aspects when implementing the Agriculture 4.0 concept. This approach is promising for agricultural development, as it allows taking into account all levels of impact, including not only technological innovations, but also social and environmental requirements, which creates a more balanced strategy for the development of the agricultural sector.

The research findings confirm that increasing production efficiency in the agricultural sector depends on the interaction of three main

factors: government support, human resources and technological innovation. The introduction of digital solutions and adaptation strategies is an important factor in optimising the use of resources, which directly affects productivity in agriculture.

CONCLUSIONS

In the course of the study, a comprehensive analysis of the current state and main problems of the functioning of agricultural enterprises in Ukraine was carried out. It was found that the key challenges for the agricultural sector remain insufficient technological development, limited access to financial resources, low level of staffing and uneven state support. This leads to lower productivity of enterprises, reduced production volumes and limited competitiveness in domestic and foreign markets.

The study found that the level of state support for the agricultural sector in Ukraine fluctuates significantly. In 2019-2021, the total amount of state support for the agricultural sector was UAH 13.3 billion, which was received by almost 19 thousand agricultural producers. In 2024, budget support decreased to UAH 4.2 billion, with the main beneficiaries being large agricultural enterprises with a land bank of more than 1,000 hectares. In 2022-2024, the 'Affordable Loans 5-7-9%' programme played a significant role in financing farmers, under which agricultural producers received UAH 33.8 billion, which is 15% of all loan agreements. This allowed farmers to obtain loans at favourable rates, which helped in modernising the production and secure liquidity. The eRobota programme, launched in 2022, has become an important tool to support farmers, particularly in the horticulture, berry growing and viticulture sectors. It provided farmers with grants to set up new businesses in these sectors.

The study of the impact of state support on the efficiency of agricultural production found that the current financing system needs to be improved. In particular, it is necessary to increase the transparency and accessibility of state subsidy programmes, and to create mechanisms for concessional lending to modernise production and introduce innovative technologies. It is important to focus on supporting small

and medium-sized farms, which play a significant role in ensuring the country's food security. Adopting the EU's experience in supporting small producers will help to increase the competitiveness and financial stability.

An analysis of the level of technological development has shown that the introduction of modern agricultural technologies, digitalisation of production processes and automation significantly increases the efficiency of agricultural enterprises. According to the data obtained, only 30% of agricultural enterprises in Ukraine implement modern digital tools, which significantly limits the possibilities of optimising production processes and increasing productivity. In addition, limited access to financial resources and high interest rates make it difficult for small and medium-sized enterprises to attract investment, which reduces the potential for development and modernisation. At the same time, the importance of providing enterprises with qualified personnel was noted. The lack of specialists in agricultural management, technology, and marketing limits the development potential of enterprises, so it is necessary to implement programmes of professional training and professional development of personnel.

Based on the study, recommendations for improving the strategic management of agricultural enterprises have been developed. It is proposed to create an effective system of partnership between agrarian enterprises and state

institutions, which will help to attract investments, develop and implement targeted programmes for modernisation of production. An important step is the formation of a favourable institutional environment that will ensure administrative capacity and transparency of the agricultural sector regulation.

Limitations of the study include the lack of sufficient statistical data, in particular on the technical support of agricultural enterprises, which makes it difficult to assess the impact of technological factors on productivity. The diversity of information sources and data collection methodologies creates difficulties in generalising the results. In addition, the lack of an obligation for enterprises to provide data on the technical equipment limits the possibilities for a comprehensive analysis. Future research includes a detailed analysis of the effectiveness of state support, an assessment of the impact of innovations on the economic performance of agricultural enterprises, and a study of mechanisms for attracting investment to modernise the sector. It is also important to explore opportunities to expand exports through international certification and integration into global markets.

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CONFLICT OF INTEREST

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Формування стратегії підвищення ефективності діяльності аграрних підприємств

Анотація. Метою статті була розробка науково обґрунтованих рекомендацій щодо вдосконалення стратегічного управління аграрними підприємствами для підвищення їхньої ефективності та конкурентоспроможності. У роботі використано методи системного аналізу, SWOT-аналізу, а також статистико-економічні методи для оцінки стану та перспектив розвитку аграрних підприємств. У статті досліджено динаміку змін у структурі виробництва сільськогосподарської продукції за категоріями виробників у 2019-2023 роках, проаналізовано вплив військових дій на обсяги експорту основних агрокультур і узагальнено основні втрати агропромислового комплексу. Встановлено, що попри значні руйнування інфраструктури та порушення логістичних ланцюгів, український аграрний сектор демонструє високу стійкість і адаптивність. Особливу увагу приділено ролі різних форм господарювання, зокрема великих агропідприємств і фермерських господарств, у забезпеченні стабільності виробництва. Наведено дані щодо частки експорту зернових культур і технічних культур, а також розглянуто зміни у структурі посівних площ, що

відображають трансформаційні процеси в аграрному секторі в умовах війни. Визначено, що низький рівень діджиталізації, дефіцит кваліфікованих кадрів і недостатня державна підтримка є основними чинниками, що обмежують ефективність аграрного виробництва. Аналіз підтвердив, що ці проблеми призводять до зниження продуктивності, обмеженої адаптації до сучасних технологій та низької конкурентоспроможності аграрних підприємств. Виявлено, що створення комплексного аграрного хабу, який поєднує освітню, технологічну та практичну складові, здатне суттєво підвищити рівень кадрового забезпечення. Запропоновано модель управління персоналом через впровадження системи безперервного навчання, використання цифрових технологій і персоналізованих планів розвитку. Обґрунтовано необхідність тісної співпраці аграрних підприємств із Міністерством цифрової трансформації та Міністерством аграрної політики для забезпечення державної підтримки і створення нормативної бази для роботи такого хабу. Отримані наукові та практичні результати можуть бути використані як основа для розробки стратегічних рішень, спрямованих на розвиток аграрного сектору в умовах післявоєнної відбудови та адаптації до сучасних економічних викликів

Ключові слова: продуктивність; конкурентоспроможність; використання цифрових технологій; державна підтримка; розвиток кадрового забезпечення



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Mechanism for adapting the social orientation of agrarian business under martial law

Abstract. The purpose of this paper was to study the peculiarities of the functioning of the Ukrainian agrarian business under martial law and to develop recommendations for adapting its social orientation for sustainable development. To achieve this goal, the methods of content, contextual, and PESTEL analysis were used. The social adaptation of the agricultural segment was considered from the perspective of the Triple Bottom Line model, which was based on the idea that the sustainable development of an enterprise determined strategic planning with due regard to the key elements: people, planet, and profit. The implementation of the model was examined on the basis of European cases: Upländer Farmer Dairy (Germany), Gailtal Alp Cheese (Austria), and Parish Grasslands Project (UK). Based on the analysis of these cases, the social reorientation of agricultural business involved multilevel and interdisciplinary cooperation between agricultural entities, the transition from extensive to intensive land management, interaction with local communities, development of green tourism, and community involvement in the preservation of sociocultural heritage. An analysis of European experience allowed the researchers to develop recommendations for the social reorientation of the agricultural sector in wartime: interaction between agricultural entities, communities, and other stakeholders to analyse social challenges and find ways to address these challenges; development of green tourism, including at the level of individual estates, family farms, and small or medium-sized farms; and integration of agricultural

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enterprises into the strategic planning and management of the communities in which these entities operated. Successful practices included the development of the cooperative movement, support for local communities, environmentally responsible farming, involvement of society in the conservation of natural resources, preservation of cultural heritage, and development of green tourism, including on the territory of family farms and individual estates. The results of the study could be used for the strategic planning of the sustainable development of agricultural business under martial law

Keywords: sustainable development; green tourism; triple bottom line; interdisciplinary interaction; corporate social responsibility; business socialisation

INTRODUCTION

The agricultural sector has been and remains one of the key components of Ukraine's economic development. The full-scale military aggression by the Russian Federation had a negative impact on the development of the sector, which was forced to reduce export volumes, lost a large part of agricultural land and faced an outflow of population, especially from places close to the active hostilities zone. In the context of instability caused by the challenges of martial law, agricultural business must demonstrate social responsibility, i.e., development that can meet the current and strategic needs of the population.

Social responsibility of business has become one of the most frequently studied topics in academic sources, in particular, in the work of S.V. Minh *et al.* (2023), according to which social responsibility ensures the achievement of corporate economic and social goals. According to E. Akanpaadgi (2023) and V. Nahornyj *et al.* (2022), the idea of social responsibility, which originated in the United States of America in the 1950s, has fundamentally changed the approach to business, proving that a business focused solely on profit has no basis for long-term functioning. S.G. Fernandez *et al.* (2023) noted that in 1994, the idea of sustainable business development was transformed into the Triple Bottom Line model, the main idea of which was that the functioning of a business is influenced by three key environmental factors: people, planet and profit. According to this model, a successful business is one whose strategic planning is aimed not only at generating profits, but also at taking care of people and the environment.

Empirical studies have shown the importance of social responsibility policies for the long-term functioning of businesses. E. Dela *et*

al. (2024) analysed data from 238 companies and found a statistically significant positive relationship between certain components of social responsibility and company financial performance. A regression analysis of Chinese companies' financial data by X. Lu *et al.* (2024) confirmed the positive impact of social aspects of a company's activities on its brand value and competitiveness. The identified link between business social responsibility and competitiveness can be explained, in particular, by investment decisions. D. Dziawgo (2024) studied a sample of 566 investors provided by the Polish Association of Individual Investors and concluded that businesses aimed at solving specific social problems are more likely to attract funding compared to businesses focused solely on profit. S. Rahmadhani *et al.* (2024) analysed corporate investments in 47 industrial and chemical companies and concluded that companies that seek to reduce negative impacts on the environment and public health are more likely to receive additional funding. According to T. Kravchenko *et al.* (2022), there is a direct positive relationship between social responsibility and financial success of a business.

In addition to investment decisions, the existence of a distinct relationship is due to the attitude of customers who prefer socially oriented businesses. I.K. Kim & K.I. Kim (2024) analysed the impact of disclosure of unethical practices in a Korean dairy producer on its financial performance in the short and long term. The researchers calculated that due to a customer boycott caused by the public exposure of unethical practices, the company's production decreased by 8%, which was equivalent to 8.1 litres of dairy products over a 12-month period. A survey of 322

McDonald's customers in Pakistan by W. Ali *et al.* (2021) confirmed the view that customers are more loyal to socially responsible companies, even if the prices of the goods and services are slightly higher than those of competitors. The above studies indicate that compliance with social responsibility standards is one of the most important prerequisites for sustainable business development in the 21st century.

The development of social responsibility in the Ukrainian agricultural sector is taking place in difficult wartime conditions. Yu. Kormyshkin (2024) noted in the study that the full-scale invasion led to losses in all areas of Ukraine's agricultural business, including export blockades, lower grain prices, power outages, and labour mobilisation. Another significant challenge was the increase in the areas that became unsuitable for agricultural activity due to large-scale hostilities, mining, pollution, flooding, etc. K.O. Patytska (2023) also emphasised the decline in investment in the agricultural sector due to restrictions caused by the wartime legal regime. The purpose of the study was to analyse the peculiarities of social orientation of business, including in times of historical challenges and uncertainty. The objectives of the work were to analyse international and national experience and development recommendations for the social reorientation of agricultural business under martial law.

MATERIALS AND METHODS

The research was based on industry reports: KSE: Centre for Food and Land Research (2023), Prospects for the development... (2024), O. Dorosh *et al.* (2024), and I. Prokopa *et al.* (2024). The cited materials were studied in order to identify the current state of development of the agricultural sector of Ukraine and to outline prospects for its social orientation. Academic studies published since 2021 were also used as materials: S. Velten *et al.* (2021), U. Chauhan & T. Purohit (2023), and T.K. Abraham (2024). The cited sources were analysed to identify the main components of the Triple Bottom Line model, highlight the advantages and challenges of using this model to achieve sustainable business development, and analyse the specifics of its use in the agricultural sector. The theoretical model recreated on the basis of the suggested

sources was used to analyse individual cases of social justice in the agricultural sector. For a detailed study of the topic, the paper used a combination of research tools: content analysis, contextual analysis, PESTEL analysis, and the case study method.

Content analysis was used to study the academic sources mentioned above. Comparative content analysis was conducted to identify the main components of the Triple Bottom Line model and the principles of its application in the agricultural sector. The purpose of the contextual analysis was to assess the state of development of Ukraine's agricultural business under martial law and to identify the preconditions for the implementation of a socially oriented policy. Contextual analysis was based on relevant industry reports and academic studies published no earlier than 2022.

The PESTEL analysis was conducted to identify the factors that shaped the development of Ukraine's agricultural sector and could affect its social reorientation during martial law. This method took into account groups of external factors that determined the activities of agricultural entities, including political, economic, social, technological, environmental, and legal factors. The factors of each group could both facilitate and hinder the implementation of the Triple Bottom Line model in the agricultural sector. The case study method was used to analyse cases of socially oriented strategies in the agricultural sector. The following cases were selected as case studies: Upländer Farmer Dairy (Germany), Gailtal Alp Cheese (Austria), and Parish Grasslands Project (UK). The choice of cases was based on the importance of the social aspect of business in European countries.

RESULTS

Development of the Ukrainian agricultural sector in wartime conditions

The development of Ukraine's agricultural sector is taking place against the backdrop of key changes, some of which began before the full-scale invasion. The most significant changes are climatic, which take the form of more frequent and intense droughts, snowless winters and a lack of meltwater. The area of steppe unsuitable for agribusiness is about 200 kilometres

and extends into Kyiv region (Prospects for the development..., 2024). The full-scale military aggression has exacerbated existing problems in the agricultural sector of the economy and led to the emergence of new ones, such as mining of agricultural land, contamination of crop areas, lowering of the level of surface and groundwater, etc. Hostilities and the occupation of certain territories also led to a reduction in the area under crops and an increase in the amount of crops not harvested. According to a report by the KSE: Centre for Food and Land Research (2023), the occupation and subsequent liberation of Kyiv, Sumy, Chernihiv, and Mykolaiv regions resulted in the destruction of approximately 15% of the baseline sown area. In the Kharkiv and Zaporizhzhia regions, this Figure reaches 50%, which

was the result of hostilities and the occupation of part of the territory. After the cessation of hostilities, 10% of the destroyed land will require active demining, 33% will be subject to demining and reclamation, and another 3% will be subject to substantial reclamation. Based on the above data, it can be stated that the Ukrainian agricultural sector is operating in a situation where the area available for agricultural activities has been significantly reduced.

The development of Ukraine's agricultural sector during martial law is also affected by the destruction of infrastructure: grain storage facilities, food warehouses, and agri-food logistics infrastructure. One of the consequences of the destruction of infrastructure was a decrease in grain exports, as shown in Figure 1 below.

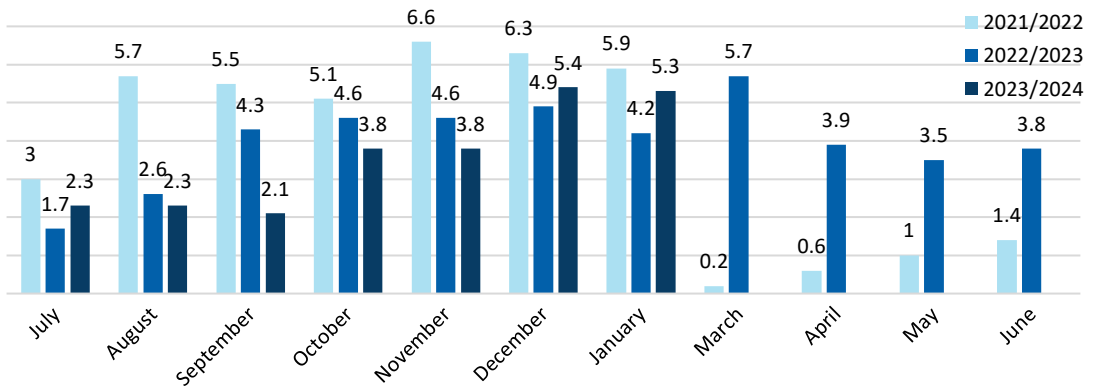


Figure 1. Export of grain products of Ukraine, million tons

Source: developed by the author based on Ukraine grain transportation (2024)

Figure 1 below shows that in 2023, there was a significant decline in grain exports due to large-scale hostilities, destruction of infrastructure and blockade of sea and land routes. In some months of 2024, there was an increase in exports compared to the previous reporting period, but it is not yet possible to say that the situation has stabilised. The production and sales of agricultural products were also affected by power outages due to large-scale shelling of critical infrastructure and grain damage. Large-scale destruction of grain storage facilities also played a significant role. O. Dorosh *et al.* (2024) estimate that in 2022-23 alone, the capacity of destroyed and damaged grain storage facilities was 8.2 million and 3.25 million tonnes,

respectively. There is a large-scale destruction of the agricultural sector, which could have a significant negative impact on its recovery and sustainable development in the long term.

In addition to the loss of crops and infrastructure, Ukraine's agricultural sector has also faced the loss of machinery and people. Experts from the KSE: Centre for Food and Land Research (2023) noted that among agricultural machinery, the largest losses were recorded among tractors and trucks, which can be used for military transport and repair, and are of increased interest to the occupiers in the temporarily uncontrolled territories. To calculate the damage caused to agricultural machinery during intense hostilities, the principle of 'better

rebuild' is used, which means that machinery that has been destroyed by 40% cannot be repaired and must be replaced with new machinery. The maintenance and repair of agricultural machinery is slowed down by the lack of workers, many of whom have been mobilised into the army or have become internally displaced. According to O. Dorosh *et al.* (2024), about 150,000 farmers were affected by the war and forced to relocate. The researchers emphasised that small farms engaged in growing seasonal products suffered the greatest losses; such farms experienced a shortage of labour due to population migration and mobilisation of workers.

These factors significantly affected the profitability of the agricultural sector and determine its future development. In the study, O. Dorosh *et al.* emphasised that as a result of the war, Ukraine's agricultural sector suffered losses of USD 2.25 billion, of which USD 1.26 billion were losses in crop production and USD 0.98 billion were losses in livestock farms. The high risks and low profitability of the agricultural sector in wartime conditions led to a significant reduction in the number of enterprises. Pursuant to I. Prokopa *et al.* (2024), as of 2024, 73,900 enterprises were registered in Ukraine, of which 50,100 were private farms, which underscores

the importance of the agricultural sector for the country's economic development. However, only 39.9 thousand of these farms were active, i.e. engaged in economic activity. For comparison, in 2021, the number of such enterprises was 46,200, meaning that the number of active enterprises in the sector decreased by 14.92% during the full-scale invasion.

Ukraine's agricultural sector is operating amidst not only an economic but also an environmental crisis, which significantly affects the well-being of workers and residents of certain areas. About a third of agricultural land has become a high-risk area due to mining and heavy metal contamination (Dorosh *et al.*, 2024). The explosion of the Kakhovka hydroelectric power plant (HPP) in June 2023 led to the flooding of 25,000 hectares of land, 38% of which is agricultural. Restoration of the flooded areas, land reclamation and return of people is not only expensive but also a time-consuming project. Further development of the agricultural segment is possible if it is socially reoriented, which means prioritising individual and community interests. As of 2024, the state has implemented initiatives to support farmers during wartime. The most significant of these initiatives are presented in Table 1 below.

Table 1. State support for the agricultural sector of Ukraine in wartime conditions

No.	Program	Essence of the initiative	Notes
1	"Affordable loans 5-7-9%"	Loans for farm development	Since the launch of the programme, 11,600 Ukrainian farmers have benefited from it, receiving a total of UAH 60.1 billion in loans
2	Grant support for small and medium-sized agribusinesses	Grants for the development of horticulture, berry growing and viticulture	Since the launch of the initiative, 108 farms developing horticulture, berry growing and viticulture have received grant support totalling UAH 428.5 million
3	Monetary compensation for lost crops	One-time financial assistance provided to the population for the lost crops as a result of the Kakhovka hydroelectric power station explosion	The amount of one-time assistance is UAH 3,318 per one hundred square metres of land where the vegetable harvest was lost. The assistance is provided for an area of no more than 20 hectares in Mykolaiv and 30 hectares in Kherson regions
4	Support for family farming household (FFH)	Compensation of the unified social tax (UST) to the private farms	In 2023, UAH 1.9 million was allocated to compensate for the unified social tax to the private households
5	Support for farmers and organisations using reclaimed land	The aim of the initiative is to increase the efficiency of reclaimed land use	Agrarians and water supply organisations will receive compensation for funds spent on equipment for land reclamation

Source: developed by the authors based on Prospects for the development ... (2024)

The table above shows that the state understands the importance of supporting the agricultural sector in wartime. These initiatives are aimed at both individual farms and agricultural enterprises. As of 2024, UAH 60.1 billion in loans were allocated to start a new agricultural business or support the sustainable development of an existing one. In addition to loans, 108 households and businesses received grant support worth a total of UAH 428.5 million. The table also shows that the state is trying to compensate households and small agricultural enterprises that suffered as a result of the full-scale military operations and related risks. The amount of such

compensation is often disproportionate to the losses incurred.

Peculiarities of using the Triple Bottom Line model in the agricultural segment

Sustainable development of agricultural enterprises in times of military uncertainty requires strategic planning that considers the people, planet, and profit pillars. By maximising these components, an organisation is more likely to have a positive impact on the world while improving its financial performance. The essence of each component of the model and the specifics of its use in the agricultural segment are presented in Table 2 below.

Table 2. Use of the Triple Bottom Line model in the agricultural segment

#	Element	Essence	Example of use
1	People	Social impact of business on stakeholders, creating value for the stakeholders now and for future generations	Financing by agricultural enterprises of education in secondary and higher education institutions, internships and further employment of graduates. Participation of agricultural enterprises in socially important projects: job fairs, financing (co-financing) the creation of safe spaces for study and recreation.
2	Planet	Minimising the impact of business on the natural environment and ecological systems	Employment of young professionals and encouraging these professionals to work with the agricultural enterprise on a long-term basis by providing housing, affordable loans, etc.
3	Profit	The overall economic impact of the business, expressed in the economic benefits that business and society receive from the organisation's business strategy	Supporting research and initiatives to improve the quality of life, social justice, etc.

Source: developed by the authors based on T. Mendes *et al.* (2021), U. Chauhan & T. Purohit (2023), T.K. Abraham (2024), Z. Caha *et al.* (2024), S. Kabbera *et al.* (2024)

Analysing the table, it can be concluded that the principles of social responsibility, which have demonstrated the effectiveness in various segments of the economy, can be adapted to the agricultural sector. Given the key role of human resources, it can be assumed that the introduction of social adaptation mechanisms will help the agricultural sector overcome the crisis caused by the

full-scale military invasion of Ukraine and plan for sustainable development in the post-war period. The social reorientation of the agricultural sector, including through the implementation of the Triple Bottom Line approach, is influenced by a set of external factors. The analysis of these factors was carried out using the PESTEL model, and the results are presented in Table 3 below.

Table 3. External factors driving the implementation of the Triple Bottom Line model in the agricultural sector

Factor	Analysis
Political	The agricultural sector of Ukraine operates under the legal regime of wartime, the specifics of which are set out in the Law of Ukraine 'On the Legal Regime of Wartime'. The legal regime provides for traffic restrictions, seizure of vehicles, mobilisation of employees, etc. These and other restrictions may affect the provision of agribusiness with the necessary material and human resources to fulfil its strategic objectives.

Table 3, Continued

Factor	Analysis
Economical	Implementation of social adaptation mechanisms requires additional investments, including from agribusinesses. In the context of economic uncertainty, companies should understand the prospects for investing in socially oriented projects, which take the following forms: an increase in the number of loyal customers, high employee motivation, low staff turnover, quick filling of vacancies, etc.
Social	There is a demand in society for socially-oriented projects that involve a responsible attitude towards customers, employees, and the community in which the company operates. Stakeholders prefer agribusinesses whose activities comply with ethical standards of transparency and accountability and are aimed at serving people, not just generating profits.
Technological	The latest technologies, including machine learning, artificial intelligence, digital governance, cloud collaboration, etc., provide agribusinesses with the knowledge and tools to plan and operate more effectively, taking into account all aspects of the Triple Bottom Line model.
Ecological	There is a need in Ukrainian society for an environmentally oriented agricultural segment. The focus on solving environmental problems includes: rational use of natural resources, preservation of natural diversity, cultivation, and reclamation of land, post-war restoration of land plots, transition to intensive management in the context of a reduction in the area of land suitable for agricultural business, and ethical treatment of animals.
Legal	The state supports the sustainable development of the agricultural sector, including through its social reorientation. At the legislative level, such support is enshrined in the document "State Support of the Agricultural Sector 2024. State and non-state funds and mechanisms".

Source: developed by the authors based on Law of Ukraine No. 389-VIII (2015), KSE: Centre for Food and Land Research (2023), Committee hearings on the topic: "State support of the agricultural sector 2024... (2024), Prospects for the development... (2024), Ukraine grain transportation (2024), O. Dorosh *et al.* (2024), O. Borodina *et al.* (2024)

Given Table 3, it is clear that each of these factors determines the strategic planning of a business entity, which focuses on a particular aspect – people, planet, or profit – or tries to combine these factors for the purpose of harmonious sustainable development. A key factor in the social reorientation of agricultural business is the public demand for stability, responsible business conduct and sustainable development at various levels of government. Government support for socially important initiatives, such as the development of family farms, the attraction of young professionals, and investments in research and development, contributes to the social reorientation of the agricultural sector and its sustainable development. The implementation of a significant number of these initiatives was suspended with the start of the full-scale invasion. The con-

straints that hinder the implementation of corporate social responsibility initiatives include, among others, a lack of economic resources to sufficiently fund all socially oriented projects, depletion of resources and the impossibility of implementing certain initiatives, especially in the areas of hostilities or in the temporarily occupied territories. In addition to the factors already mentioned, Ukraine has little experience in implementing the Triple Bottom Line model in strategic planning and management of the agricultural sector.

Adapting the social orientation of agribusiness: European experience

The effective implementation of the Triple Bottom Line model in the agricultural sector was investigated using the example of three farmer associations presented in the table below.

Table 4. Social orientation of agribusiness: European experience

#	Name/country	Social perspective	Achievement
1	Upländer Farmer Dairy/Germany	An association of organic milk farmers from Hesse. The association specialises in milk collection, production, and sale of dairy products	The association was founded in 1986 and initially consisted of 8 organic dairy farms. In 1996, with the acquisition of Upländer Farmer, the association transformed its activities: its members not only sold raw milk but also processed it into finished dairy products for further sale in the region and the country. As of 2021, Upländer Farmer Dairy had 130 farms

Table 4, Continued

#	Name/country	Social perspective	Achievement
2	Gailtal Alp Cheese/Austria	The company specialises in raising livestock and producing Gailtal ham and cheese, whose unique recipe is protected by a trademark. Since 2001, the company has also been organising an annual ham and cheese festival, which attracts tourists from across the country and abroad	The history of Gailtal Alp Cheese began in 1989, when Galital Alp cheese became a candidate for Protected Denomination of Origin status. In 1996, the state granted Gailtal Alp cheese Protected Denomination of Origin status and encouraged farmers' associations in the fourteen mountain chalets in the administrative district of Hermagor, where the cheese was traditionally produced, to form groups to preserve the farming practices, traditional recipes and hold an annual festival
3	Parish Grasslands Project/UK	The project covers the communities of Brockweir, Hevelsfield and St Briavels, which are located in the fields of a former nature reserve and remained in a semi-natural state until the early 2000s. The network of smallholders is based on informal arrangements and aims to conserve natural diversity and raise public awareness of environmental issues in the region	Established in 2001, the Parish Smallholders' Organisation helps residents to keep the fields flourishing and to increase the community's interest and knowledge of the surrounding landscape. Its educational activities take the form of lectures, field meetings, school programmes, publications, etc., with the main objective of bringing together active residents to address environmental issues in the region. Educational activities are also aimed at farmland owners who want to plan the activities in accordance with the principles of sustainable development

Source: developed by the authors based on S. Velten *et al.* (2021)

It is clear from the table below that although the entities consider all aspects of the triple bottom line, each case study analysed involves a shift in focus according to strategic goals and realities. In the case of Upländer Farmer, Germany, there is a focus on profit through the consolidation of business entities. Representatives of Gailtal Alp Cheese, Austria, focused on people as a driving force for effective management, preservation of traditions and community development. The main focus of the Parish Grasslands Project was on the planet, which was manifested in the desire to preserve the natural diversity of the region.

The analysis of these cases allows drawing several conclusions about the use of the Triple Bottom Line model that can be used in planning the social orientation of the Ukrainian agricultural sector. One of the key conclusions relates to the public demand for socially oriented businesses that care about the quality of life of consumers and the overall well-being of society. The public desire for a high quality of life is expressed, among other things, through the growing demand for quality products of organic origin. The story of Upländer Farmer Dairy, which started as an association of 8 farms and

later expanded to 130, is an illustration of this public demand (Velten *et al.*, 2021). This fact proves the high public demand for organic farm products that have been grown in compliance with key ethical conditions. The reorientation of Upländer Farmer Dairy's activities from the sale of raw milk to the production and sale of dairy products is also important. This reorientation allowed the farms to gain full control over production processes and thus meet the key commitments to customers. The analysed case highlights that a socially oriented business understands the needs of consumers and strives to meet these needs ethically.

The analysed cases also prove that the public demand is not limited to the quantitative and qualitative characteristics of the goods consumed, but also includes the desire for the rational use of natural resources and the preservation for future generations. An example of such a demand is the unification of the British communities of Brockweir, Hevelsfield and St Briavels into the Parish Grasslands Project. Such an association has helped to draw public attention to the rational use of land resources and the preservation of natural diversity in the face of bureaucratic obstacles. The example of the

Parish Grasslands Project proves that community-based initiatives have significant potential to develop and scale up when supported by a community that is interested in a clean environment, natural diversity, sustainable use of resources and the associated high quality of life. The case study also demonstrates that there is no direct positive correlation between the financial capabilities of individual agricultural actors and the effectiveness of the socially oriented initiatives. In the case of the Parish Grasslands Project, positive changes were made thanks to the efforts of individual land users who did not have the financial resources to implement large-scale social initiatives. The success of the Parish Grasslands Project was due to the public support that resulted from active educational activities. One of the objectives of such activities was to identify common interests and goals of the community and business, and to find strategies to achieve these interests and goals. The British case study proves the importance of socially oriented initiatives and proves that the success depends on an open dialogue and constant interaction between the business, which is the initiator and implementer of the initiative, and the society, which is its consumer.

The analysed cases also prove that although government support can be a key argument in deciding whether to implement a socially oriented initiative, its significance decreases or disappears over time. The case of Gailtal Alp Cheese, an association that was created with government support to make the transition from extensive to intensive agriculture and preserve national recipe traditions, can serve as an illustration of this statement. The first annual cheese and ham festivals held in the administrative district of Hermagor since 2001 were supported by the state; however, subsequent events were organised by groups of local activists who turned the festival into an effective advertisement for green tourism. The example of Gailtal Alp Cheese proves that socially oriented programmes in the agricultural sector can exist without significant support from the state and continue the sustainable development even in the face of unfavourable political or economic conditions. This conclusion is especially important for the Ukrainian agricultural sector, which

has to develop in an unfavourable environment and with insufficient state support.

In addition to the findings already mentioned, all the cases highlight the importance of cooperation for the implementation of socially significant projects in the agricultural sector. The nature of cooperation allows it to maximise the potential of socially oriented programmes while minimising potential costs or losses. The importance of cooperation lies in the fact that it is a source of material resources necessary for the implementation of social mechanisms in the agricultural sector. This is illustrated by the case of Gailtal Alp Cheese, where public funding enabled the first cheese and ham festivals to be held and thus promote green tourism in the administrative district of Hermanagh. Cooperation is also a source of knowledge and ideas that form the basis of successful socially important initiatives in the agricultural sector. An example is the Upländer Farmer Dairy, where an increase in the number of participants leads to the presentation of new ideas or the refinement of already implemented ideas for improving and controlling the quality of organic products. Examples of effective cooperation between individual business entities can be used in the planning and implementation of social mechanisms in the agricultural sector of Ukraine.

Given the experience of European agricultural enterprises, recommendations can be offered for adapting the social orientation of the sector. The key recommendation is the development of partnerships at different levels – ‘agricultural enterprise – state’, ‘agricultural enterprise – agricultural enterprise’, ‘agricultural enterprise – producers/suppliers’, ‘agricultural enterprise – buyers/community’, etc. – in order to exchange knowledge and experience, find effective management strategies and social reorientation of agricultural enterprises and ensure an even distribution of resources. It is recommended to develop partnerships, which are a source of ideas for implementing the Triple Bottom Line model by agricultural entities. One of the tasks of the partnership is to create a network of agricultural enterprises that have accumulated experience and have the tools to adapt the social orientation in conditions of uncertainty, including martial law. In addition to

the above recommendations, it is worth proposing the development of green tourism, which is gaining rapid popularity around the world, as it promotes the idea of saving natural resources and caring for current and future generations. Based on the European experience, it is also recommended that agricultural enterprises be integrated into the life of the communities in which these enterprises operate. Such integration implies a change in the strategic focus of agricultural enterprises – from the profits to be made by operating in a particular community to the benefits that can be brought to the community in the short, medium and long term.

DISCUSSION

The results of this work, including recommendations, have been confirmed in previous studies. The importance of partnership in the planning and implementation of social initiatives in the agricultural sector was, in particular, confirmed in the work of S. Chen & K.M. Kamarudin (2024), who investigated the impact of partnership on the achievement of strategic management goals. Based on data obtained through a survey of 467 respondents and analysed by structural equation modelling, the researchers concluded that stakeholder cooperation forms co-creation of value and has a positive impact on strategic planning. S.I. Mulyani *et al.* (2024) analysed the results of the Spice Village partnership programme in Indonesia and concluded that partnerships at the local and regional levels are the key to continuous improvement in the agricultural sector. M.S. Pechrova & O. Simpach (2024) studied the peculiarities of the agricultural sector in the Czech context and concluded that partnership, which takes the form of agricultural holdings, is a prerequisite for the competitiveness of enterprises in the face of economic instability. Based on the study cited, cooperation between stakeholders, such as an agricultural enterprise, the state, and society, can be seen as a platform for finding common interests and developing strategies to achieve these interests.

The importance of partnerships in the social reorientation of the agricultural sector was also emphasised by J. Lafont *et al.* (2023), who studied the role of cooperatives in the sustainable

development of farms. A systematic analysis of studies has shown that the sustainable development of agricultural enterprises is often conditioned by the functioning within a cooperative, which is considered a source of resources and strategically important knowledge. The researchers also identified 8 types of cooperatives (production, consumer, labour, housing, financial, multilateral and new generation cooperatives), thus highlighting the variability of interaction and the possibilities for its implementation in different contexts.

Partnerships in socially significant projects can take various forms, in particular, for the development of green tourism, a promising area that has received wide coverage in the academic literature. M. Saleh & S.M. Faisal (2024) noted that green tourism is gaining popularity and can become an alternative to traditional tourism as a source of environmental pollution. According to the data provided by the researchers, traditional tourism accounts for 11% of total carbon emissions, and this share could double by 2050. According to L. Horbach *et al.* (2024), green tourism is safer for the environment and is therefore recommended for development in areas that have experienced or may experience negative environmental impacts. A correspondence was found between the cited study and the case of Gailtal Alp Cheese, based on lands that have suffered damage from extensive management.

U. Tafsirun *et al.* (2024) analysed the responses of 211 tourists and concluded that participation in green tours increases the target audience's awareness of environmental issues and motivates the tourists to make conscious consumer decisions. Based on the study, green tourism can be seen as a way to raise public awareness of environmental issues and draw the attention to agricultural entities that are actively involved in solving these problems. The use of agricultural enterprises as a platform for green tours helps to create the positive image, increase consumer loyalty, enhance competitiveness and sustainable development in the face of economic uncertainty.

In the study, K. Stamatiou (2024) emphasised that green tourism creates conditions for interdisciplinary cooperation in order to attract

as many stakeholders and potential sponsors as possible. Citing the experience of Greece, the researcher emphasised that green tours can integrate historical, cultural, country studies and other components that are of interest to the target audience. In the paper presented here, an example of such integration is the annual Gailtal Alp Cheese festivals, where visitors not only learn about the geographical, climatic and environmental challenges of the region, but also learn more about its history and culture, including traditional recipes as part of the intangible heritage of the people.

In Ukraine, the development of green tourism can become one of the areas of social re-orientation of the agricultural segment of the economy by attracting public interest in certain regions and/or production methods, creating new jobs, promoting the idea of rational environmental management, etc. As of 2020, the nature reserve fund (NRF) of Ukraine amounted to 3.911 million hectares, including natural and biosphere reserves, national parks, botanical and zoological gardens, monuments of landscape art, and protected tracts that could become locations for green tourism (Boiko, 2020). N. Marchyshyn & N. Ostrovskaya (2022) emphasised that due to its vast territories and natural diversity, Ukraine has the potential to develop green tourism and promote the socially significant idea of rational use of natural resources.

In wartime, opportunities for green tourism development are somewhat limited due to the location of some agricultural enterprises directly in or close to the area of intense hostilities, restrictions on movement in certain areas, population migration and the economic crisis. Small and medium-sized farms, estates, and agribusinesses demonstrate greater resilience and ability to develop sustainably in the face of uncertainty, such as the rural tourism at the Zelenyi Hai cheese factory in Dnipro region, Staryi Khutir in Poltava region, or Trout Estate in Kolochava village, Zakarpattia region (Tabenska, 2024). Studying the experience of these and other private estates, cheese dairies, ponds, etc. allows concluding that green tourism is feasible and has prospects for development as one of the strategies for social orientation of the national agricultural sector.

In addition to the above recommendations, it is worth proposing a more intensive integration of agricultural enterprises into the life of the community in which these enterprises operate. In this paper, the inseparability between the agricultural enterprise and the community was illustrated, in particular, by the example of the Parish Grasslands Project, where community members became the driving force behind strategic planning and sustainable development of the agricultural sector. The importance of the community in strategic planning of the agricultural sector has been confirmed in previous studies, for example, F. Almeida (2024), who investigated the role of communities in the sustainable development of the agricultural sector in Portugal. The researchers' systematic analysis of 15 scientific sources confirmed the key role of the community in researching and addressing such issues of sustainable development and social orientation of the agricultural segment as water management, organic composting, land reclamation and soil fertility improvement. R. Abdullah *et al.* (2024) confirmed the importance of community involvement as a factor in motivating small and medium-sized farms to further develop, improve the quality and increase the volume of the activities.

Recommendations on mechanisms of social adaptation of the Ukrainian agricultural segment are based on contextual analysis, research of European cases, and comparison with the previously presented data. Given the representativeness of the sample, it can be argued that the recommendations are relevant and realistic, despite the peculiarities of the context in which the national agricultural sector is forced to develop.

CONCLUSIONS

The study analysed the social orientation of Ukraine's agrarian business under martial law, which allowed to identify key factors of its adaptation and formulate strategies for sustainable development. It is established that the agricultural sector of Ukraine has suffered significant losses due to the destruction of infrastructure, reduction of sown areas, migration of workers and aggravation of environmental problems. These factors have negatively affected the financial stability of agricultural enterprises and the

ability to plan for the long term. Analysis of international experience has shown that social responsibility of business contributes to its financial sustainability, investment attraction and increased consumer confidence. Ukrainian agricultural enterprises can use the Triple Bottom Line model, which includes economic, environmental and social components. It is concluded that sustainable development of an enterprise is based on strategic planning that takes into account not only financial interests, but also the social and environmental needs of the community in which the agricultural enterprise operates.

The case studies of European companies, including Upländer Farmer Dairy (Germany), Gailtal Alp Cheese (Austria) and Parish Grasslands Project (UK), have shown that social responsibility contributes to the sustainable development of the agricultural sector even in the face of economic uncertainty. Successful practices include the development of the cooperative movement, support for local communities, environmentally responsible farming, public involvement in the conservation of natural resources, preservation of cultural heritage and the development of green tourism, including on the territory of family farms and individual estates. Based on the European experience, recommendations were developed for the social reorientation of Ukrainian agricultural enterprises in wartime. It was proposed to develop multi-level and interdisciplinary partnerships to find effective strategies and mechanisms for social adaptation of the agricultural sector. Initiatives were also proposed

to develop green tourism, which is a source of new jobs, economic development and addressing urgent community needs. Active integration of agricultural enterprises into community life was also recommended in order to better understand social needs and strategies for the implementation.

This paper has several limitations, including the lack of sufficient empirical data on the long-term impact of the war on the agricultural sector; the inability to assess the full extent of environmental impacts due to mining, soil destruction and water pollution; and uncertainty about the future dynamics of hostilities, which makes it difficult to predict the development of the agricultural sector. The identified limitations can be addressed through further research, which aims to conduct a more detailed analysis of the impact of socially responsible business on the resilience of the agricultural sector in times of crisis; develop effective models of partnership between the state, agricultural business and NGOs to restore the sector; analyse the potential of green tourism and its integration into the system of socially responsible agribusiness; and explore the possibilities of adapting European approaches to sustainable development of the agricultural sector in the context of Ukraine.

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CONFLICT OF INTEREST

None.

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Механізм адаптації соціальної спрямованості аграрного бізнесу в умовах воєнного стану

Анотація. Метою даної роботи було дослідити особливості функціонування аграрного бізнесу України в умовах воєнного стану та розробити рекомендації адаптації його соціальної спрямованості задля сталого розвитку. Для досягнення мети були використані методи контент-, контекстуального та PESTEL-аналізу. Соціальна адаптація аграрного сегменту була розглянута з точки зору моделі Потрійної нижньої межі (Triple Bottom Line), яка ґрунтується на ідеї, що сталий розвиток підприємства обумовлює стратегічне планування із врахування ключових елементів: громади (people), планети (planet) та прибутку (profit). Впровадження моделі було розглянуто на прикладах європейських кейсів: Upländer Farmer Dairy (Німеччина), Gailtal Alp Cheese (Австрія) та Parish Grasslands Project (Великобританія). Спираючись на аналіз цих кейсів, соціальна переорієнтація аграрного бізнесу передбачає багаторівневу та міждисциплінарну співпрацю суб'єктів аграрного господарювання, перехід від екстенсивного до інтенсивного землеуправління, взаємодію із місцевими громадами, розвиток зеленого туризму та залучення громади у збереження соціокультурної спадщини. Аналіз європейського досвіду дозволив розробити рекомендації щодо соціальної переорієнтації аграрного сегменту в умовах воєнного часу: взаємодія суб'єктів аграрного господарювання, громади та інших зацікавлених сторін для аналізу соціальних викликів та пошуку шляхів їх рішення; розвиток зеленого туризму, в тому числі, на рівні індивідуальних садіб, сімейних ферм та малих або середніх фермерських господарств; інтеграція аграрних господарств у стратегічне планування та управління життям громад, на території яких вони функціонують. Успішні практики включають розвиток кооперативного руху, підтримку місцевих громад, екологічно відповідальне ведення господарства, залучення суспільства до збереження природних ресурсів, збереження культурної спадщини та розвиток зеленого туризму, в тому числі на території сімейних фермерських господарств та індивідуальних садіб. Результати дослідження можуть бути використані для стратегічного планування сталого розвитку аграрного бізнесу в умовах воєнного стану

Ключові слова: сталий розвиток; зелений туризм; потрійна нижня межа; міждисциплінарна взаємодія; корпоративна соціальна відповідальність; соціалізація бізнесу



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Risk assessment in the development of strategy for the use of company's resource potential under modern conditions

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Abstract. Rational use of resources minimises the risks associated with the implementation of a company's objectives in the context of changing global financial and economic conditions. The aim of this study was to identify the key threats in the process of strategic planning of enterprise development through an analysis of its potential and the volume of its resource base. The main research methods used were systems analysis (to outline the components of the problem) and the historical method (to consider the stages of formation and development of the system for assessing the resource potential of an enterprise). It was found that the concept of resource potential utilisation and the associated processes are interpreted in various ways, grouped according to characteristics, features, and specificities. The analysis of companies such as Google and MySpace revealed that the practice of developing and using strategies for applying the resource base is most effectively implemented by corporations operating primarily in the technological and information sectors. These companies utilise their entire resource base (human resources, technological capacity, financial capabilities, innovative knowledge, intellectual capital) in their operations. It was established that, based on these resources, a company builds a development strategy that includes scenario monitoring, strategic planning, strategy implementation, and allows for bypassing or omitting certain stages while introducing new ones. Through risk assessment (e.g. continuation of hostilities, intensified mobilisation, etc.), the potential intensity of their impact on further trends in entrepreneurial activity in Ukraine was emphasised. It was found that for Ukrainian enterprises that continue to operate under wartime conditions, the implementation of risk management measures is a critically important task, particularly in the search for alternative development paths. The results can be used as practical input for further academic research on this topic

Keywords: economic activity; capital; management system; innovation; digital tools

INTRODUCTION

In the face of the sharp and unpredictable transformations of global development in the 21st century, it is essential to maintain strong positions with a clear understanding of the challenges and complexities of the new order. This issue is relevant not only for civil society but also for the business sector, as the latter plays a crucial role in the development of specific groups and populations, and the overall well-being of the state. Careful planning of development strategies and assessment of potential risks in the process of achieving a company's goals and objectives is a particularly timely and relevant issue. The organisation's ability to withstand internal and external challenges largely determines its success as an effective economic entity. Under the stress of Ukraine's development, driven by war and economic instability, the creation of an effective, flexible, modern, and adaptive enterprise strategy becomes a key priority for rapid post-crisis recovery.

Each industrial sector and area of economic and financial development has its own specific risks and challenges in the execution of its tasks. The formation of a single, universally effective

strategy that takes into account all potential complications is unrealistic due to the unviability of such a solution. Therefore, it is important to thoroughly study the methods and approaches to planning an organisation's activities within the framework of using its resource base, considering all possible challenges and complications in order to minimise or completely avoid such risks as a phenomenon.

Risk, as an economic concept, is an inherent part of any enterprise's activity. According to V. Baldyniuk (2023), risk forms the foundation and consolidates the accumulated experience of enterprises, whether positive or negative, depending on the consequences of a specific risk. A company's strategic potential is viewed as a dynamic system encompassing resources, competencies, all possibilities, and available reserves required to achieve the objectives outlined in its strategy. This potential, according to H. Mohonko & D. Trokhymchuk (2024), can be effectively utilised under a rational approach. The innovative component of a company's strategic development is a key element of its sustainable evolutionary transformation in the 21st century.

As noted by O. Krupskiy *et al.* (2024), this enables not only the modernisation of numerous internal technical processes but also creates conditions for more transparent communication between the enterprise and its clients, partners, and other stakeholders. However, according to F. Kitsios *et al.* (2022), the reckless and comprehensive implementation of new information systems and digital infrastructures can do more harm than good.

H. Liu (2023) argued that a company's resource potential should be used solely for current operational needs, taking into account the likelihood of various risks in different sectors. However, the determining factor in achieving goals and objectives must be the development of a sound strategy – to minimise the emergence of risk situations and phenomena with negative consequences. A logically structured system for planning resource use represents a complete and integral framework, the implementation of which does not allow for its fragmentation or the use of individual parts or stages. C.-S. Chirvase & A. Zamfir (2023) saw broad opportunities for improving company operations within this system. However, they also warned that if an irrational and careless approach is taken to selecting specific development paths, the strategy itself may lead to harm or give rise to new, unpredictable risks.

A risk management system within an enterprise does not always involve direct confrontation with risks or their consequences. Y. Chen (2023) noted that many companies do not differentiate much between approaches to mitigating threats. The safest approach in terms of avoiding negative outcomes is to refrain from any actions that could theoretically pose a risk. However, such a position, as argued by J.V. Baraza de la Paz *et al.* (2023), cannot lead to financial growth. G. Golik-Górecka (2022) considered the idea of “shared responsibility” for risks among stakeholders to be optimal and logical, particularly in light of growing demand for services such as comprehensive risk insurance. Nonetheless, the most effective – though moderately risky – approach, according to E. Calderon-Monge & D. Ribeiro-Soriano (2024), is to continue regular business operations while carefully planning resource strategies and continuously evaluating

internal reserves and external conditions in the context of potential threats and risks when making decisions. One underexplored topic in the literature is how Ukrainian enterprises choose response strategies in the face of risks caused by a combination of adverse conditions, including economic challenges and full-scale war.

The purpose of the study was to identify and outline the main challenges and risks associated with the formation of a roadmap for the development of an industrial enterprise through the planned utilisation of its strategic resources (in particular, human capital, production facilities, and technological developments). The study aimed to review the key stages in the process of using the enterprise's resource potential; determine the main challenges and difficulties encountered when planning a development strategy for such an enterprise under crisis conditions caused by external factors; and to provide practical recommendations for improving the planning and implementation of the resource base in order to ensure the enterprise's stable progress.

MATERIALS AND METHODS

To build a logical-conceptual framework and understand the overall situation in the sphere of the country's industrial development and the specific features of the functioning of individual enterprises, companies, and corporations – entities which collectively constitute the national resource potential – key elements and components necessary for an in-depth study of this topic were identified (for example, key concepts such as “resource potential,” “enterprise development strategy,” and “entrepreneurial potential” were examined using thematic grouping of terms). Capitalisation volumes, elements of risk assessment system development, the stages of transformation in approaches to the understanding of enterprise resource base development strategy, and other statistical data were presented to demonstrate the effectiveness of various methods in the strategy formation process. Data were selected from open sources – statistical reports, analytical reviews, and informational bulletins (World's largest companies in 2024, 2024; Rangroo, 2024) – due to their relevance and the flexibility with which results could be presented

(by year and sector). To obtain further information and context, reference data were used: I. McCue (2020), O. Danilov (2023); Largest companies by marketcap, (n.d.); N. Palyvoda (2024); A. Hayes (n.d.); M. Derkach (2024); Annual revenue of Alphabet... (n.d.).

The operations of companies were analysed, including the ERP solutions adopted by global corporations such as Google (Beattie, 2024; Google Workspace ERP software market, n.d.; What ERP does Google use?, n.d.) and MySpace (Shylkouskaya, 2024). Various elements and tools were compared, contributing to a number of conclusions. For instance, selecting paths for further organisational development based on the scale of available resources proved useful in terms of the practical value of the results. For this, SWOT analysis was employed to examine different approaches to risk assessment during the planning of enterprise resource utilisation, including risk assessment methods depending on the institution's sectoral orientation. The stages of economic activity development of any enterprise, specifically in terms of forming a development strategy for the enterprise's resource base over different timeframes, were considered by analysing the conceptual understanding and real industrial needs at a given moment in time.

To clarify and verify the collected data, Ukrainian regulatory acts, reports and reviews were analysed: Order No. 446 "On the Adoption and Cancellation of National Standards, Adoption of Amendments to the National Standard" (2018); Issue "Ukraine: Recovery..." (2024). The official document ISO 31000:2018 – International Standard (2018) was also considered.

RESULTS

Global trends in entrepreneurial activity

Various technological processes, the business sector, and trade-economic relations have acquired exceptional importance for the sustainable transformation of the state amid the globalisation processes of the early 21st century (Golik-Górecka, 2022). Alongside the broad opportunities available to enterprises directly involved in key industries such as manufacturing, economics, goods and services, it is essential to adequately assess the surrounding situation

and monitor internal changes. This enables timely responses to potential threats and risks and supports the formation of a flexible and effective strategy for the use of an enterprise's resource potential to ensure successful development (Abdelwahed & Soomro, 2023).

There are a number of corporations whose operations serve as benchmarks in the intelligent and thoughtful use of resource potential through the implementation of risk management technologies. For example, in the early 21st century, Google structured its activities based on hiring employees exclusively with the highest levels of education, excellent qualifications, and favourable references from previous workplaces, without placing emphasis on employees' personal and psychological qualities. As a result, the efficiency of their joint work was relatively low since each employee focused on individual results rather than teamwork. This led to negative trends, such as declining ratings, low investment volumes, and diminished profits, which became key risks for the corporation. However, following a review of its development strategy (identifying current problems and associated risks, inventorying available resource capabilities – particularly in the context of educational programmes for new employees), Google radically transformed its recruitment approach. The company began hiring young specialists, often without experience but with promising ideas. Thanks to this and continuous educational support for these employees, it managed to build a global network and become a leader in its sector (Beattie, 2024). The advantages of this new approach are evidenced by company statistics: prior to the implementation of a differentiated recruitment approach, when nearly 80% of employees held higher education degrees, only 7% of proposed ideas materialised into fully-fledged start-ups or working models/prototypes. After reducing the proportion of highly educated employees by nearly 50% and increasing the share of youth with a medium level of education by 20%, the rate of implementation of new technological solutions rose to 40%. This demonstrates Google's management's clear adherence to the principles of equality and diversity. Similar processes occurred in other corporations (Table 1).

Table 1. Top corporations (enterprises, organisations) by capitalisation as of the end of 2024

Place	Corporation	Information (capital*, country of incorporation, year of incorporation)	Business line
1	Nvidia	3,600, United States of America, 1993	Computer equipment, online streaming, games, gaming accessories
2	Apple	3,449, United States of America, 1976	Consumer electronics, software, online services, games, gaming accessories
3	Microsoft	3,173, United States of America, 1975	Software, online services, games, gaming accessories
4	Amazon	2,223, United States of America, 1994	E-commerce, online services, online streaming
5	Google	2,159, United States of America, 1998	Software, search services, online services, advertising, entertainment content
6	Meta (Facebook)	1,457, United States of America, 2004	Social network, software
7	Tesla	0.998, United States of America, 2003	Production of new generation cars, robotics
8	TSMC	0.977, China, 1987	Microprocessors, semiconductors, computer equipment
9	Broadcom	0.977, United States of America, 1961	Semiconductors, software
10	Oracle	0.518, United States of America, 1977	Software, service support, data security, information protection, database management systems

Note: * – trillion dollars

Source: compiled by the authors based on: O. Danilov (2023), E. Calderon-Monge & D. Ribeiro-Soriano (2024), World's Largest Companies in 2024 (2024), A. Rangroo (2024), M. Younus *et al.* (2024)

By analysing the data from Table 1, it can be concluded that the most technologically advanced enterprises in terms of logical and sustainable utilisation of resource potential are those operating in the fields of innovation, internet technologies, online systems, and software. These areas of activity require manufacturers to constantly monitor the current situation and respond swiftly to potential risks and threats. Therefore, by employing their existing resource potential and making use of various tools and methods to carry out their operations, these corporations are the most profitable and financially stable.

The resource potential of an enterprise refers to a structured set of tools, including material, intangible, professional (labour), economic (financial, monetary), and innovation-technological resources, which enable it to perform its tasks within its defined authority to achieve its founding objectives (Chen, 2023). Entrepreneurial potential (enterprise potential) is the ability of an individual (entrepreneurial potential) or

a group (organisational potential) to act within the framework of innovative development, active transformation, independent formation of future vectors, financial competition, and situational risks (Taher *et al.*, 2020). Resource potential is defined as a system of interrelated and logically distributed types, sets, and segments within the structure of enterprise activity, which the enterprise can freely manage and utilise to ensure its successful development (Katuu, 2020; Zumaľ & Sibindi, 2023).

These concepts are sometimes equated, justified by the following factors: the resource potential of an enterprise is, to a greater or lesser extent, its general potential; personnel, technical equipment, and financial tools are simultaneously both resources (initial stage) and potential (stage of expansion and adaptation) (Al-Amin *et al.*, 2020; Liu, 2023). In this context, the resource potential of an enterprise has a complex structure, with elements overlapping to form the overall appearance of an enterprise's potential (see Table 2).

Table 2. Structural elements and evaluation criteria of an enterprise's entrepreneurial (resource) potential

Type	Components	Criteria
Intellectual Capital	Staff qualifications	Professional level of staff, education level, dynamics in adopting non-standard decisions

Table 2, Continued

Type	Components	Criteria
Innovative Developments	Patents, licences, trademarks	Novelty of adopted decisions and products, number of start-ups, developments/technologies, commercialisation level, digitalisation, number of implemented business proposals
Financial Component	Monetary resources	Volume of capital investments, cash inflows, ratio of income to expenditure
Material and Technical Base	Equipment and machinery	Software quality, quantity of necessary equipment, efficiency of devices in crisis situations
Workforce	Personnel (all categories)	Number and structure of employees, staff turnover dynamics, labour productivity coefficient
Information Component	Dissemination and promotion of information	Number of public events held, scale and quality of advertising campaigns, efficiency of attracting external stakeholders

Source: compiled by the authors based on: A. Taher *et al.* (2020), H. Liu (2023), C.-S. Chirvase & A. Zamfir (2023), N. Zumař & N. Sibindi (2023), O. Krupskiy *et al.* (2024)

Given the need to assess the enterprise's resource potential for the purpose of fully utilising its available capacities, it is essential to consider all components that together form the basis for carrying out designated tasks within the enterprise. Traditionally, firms possess groups of resources such as human potential, innovative developments, technological capacities, financial flows, and information components. Each element of the resource base is characterised by its own efficiency indicators. For example, regarding human resources, it is important that employees have the necessary qualifications, are experts in their field, and possess key skills to perform specific tasks. Financial resources should be sufficient to cover all expenses and be available for use in unforeseen circumstances. Innovative developments and intellectual potential should be reflected in the number of new solutions, designs, and methods (particularly relevant for technology-driven enterprises). Information capacities should be of a high standard, especially for firms that actively publicise their activities externally (e.g. in the social sector, cultural sphere, or education).

With regard to the concept of risk in entrepreneurial activity and its evaluation as a direction of focus, this aspect can be defined as a systematic process aimed at identifying, classifying (assessing), and minimising the negative consequences of potential risks in an enterprise's operations. Minimisation may involve either the complete elimination of consequences or the establishment of a risk mitigation system, including measures of control, monitoring, and

management. Risk impacts can occur across different areas (financial, operational, systemic, logistical, technical, legal), yet all affect the enterprise's ability to function effectively and responsibly within its mandates while fully utilising its available resource potential.

In the practice of Western institutions, the concept of enterprise risk management is widely applied. This involves managing risks through a comprehensive approach, including aspects such as risk identification and assessment, preparation for mitigation, and implementation of measures to reduce consequences (Hayes, n.d.; Darwish *et al.*, 2021; Alawattegama, 2022). Closely linked to risk assessment practices is the system of resource planning, which serves as a key tool for the successful functioning of all processes (business and technological) within a modern enterprise (McCue, 2020; Ashik Sheik & Sulphrey, 2020; Talasi & Seymour, 2022).

Enterprise development strategy: essence and content

The resource base of any enterprise serves as the foundation for its formation, development, improvement, and adaptation to changing external conditions. Almost everything depends on the properly chosen business strategy: financial growth, corporate image, and even a positive internal climate among staff. The choice of strategy is influenced by many factors, but an important role is played by the preparatory activities undertaken before the actual selection of the strategy and the execution of its objectives (see Table 3).

Table 3. Stages of planning and utilising the enterprise's resource base (before and after strategy development)*

Step	Activity description
<i>Before strategy development</i>	
1	Identification of key components to be assessed during the enterprise development strategy selection process
2	Determination of the methodology for evaluating the selected components
3	Formation of quantitative and qualitative indicators to be calculated in the assessment process
4	Evaluation of the selected components
5	Assessment of the enterprise's overall production potential
6	Interpretation of assessment results (risks, advantages, impact of internal and external environments, forecast of future development scenarios)
7	Selection of strategy options
8	Choice of the strategy for utilising the enterprise's resource potential
<i>During Strategy Implementation in the Enterprise's Practical Operations</i>	
9	Development of mechanisms and approaches for effective strategy implementation
10	Monitoring of strategy performance results, strategy adjustment
<i>Strategy Embedded into the Enterprise's Operations</i>	
11	Collection of information on enterprise performance outcomes under the strategy
12	Error consideration, decision-making regarding threats and risks, continuation of enterprise operations

Note: * the process of strategy development and the stages involved are unique to each enterprise depending on its sector. Strategies may include additional, non-mandatory but contextually necessary steps, while some standard steps may be excluded if deemed unnecessary

Source: compiled by the authors based on: F. Kitsios & M. Kamariotou (2021), V. Pratama *et al.* (2021), J.V. Barraza De la Paz *et al.* (2023), N. Palyvoda (2024)

Adhering to the stages required for planning and utilising the enterprise's resource base is generally obligatory for ensuring stable institutional performance. However, under certain conditions (e.g., non-standard operational settings), it may be possible to transform or omit specific stages. For instance, when developing a strategy for launching an updated version of an existing product, the stage of assessing the resource potential directly related to its production may be simplified to a general review based on a previously conducted detailed analysis of the main product.

ERP, as a key factor in enabling enterprises to achieve their strategic goals and objectives,

has become a standard tool in 21st-century business practice (Kitsios & Kamariotou, 2021; Patel, 2024). The resource planning system has a long history, during which not only its components but also the processes it influences have evolved (see Table 4). From launch to full operation, more and more enterprises worldwide have adopted its elements and tools. A major feature of ERP in the early 21st century is the expansion of system capabilities through the use of modern information and communication technologies, enabling the successful development of enterprise strategies and effective use of resource potential with due consideration of threats and risks (Barraza de la Paz *et al.*, 2023).

Table 4. History of the creation and development of ERP

Years	Events
1960s	Among manufacturers and clients of industrial enterprises, the need arose for additional protection against potential risks and threats. Specialists developed the first systems and tools for planning the use of resource potential.
1970s	The scope of ERP system usage expanded. The volume of developments and updates to the initial planning mechanisms considering risks increased.

Table 4, Continued

Years	Events
1980s	A new phase of developing resource base planning systems considering threats began. The emergence of more powerful software accelerated implementation processes.
1990s	Further expansion of ERP capabilities. Functionalities were increased, and new services and advanced features were added.
2000s	Large-scale digitalisation of ERP. The integration of online tools, internet services, and digital mechanisms into the system.
2010s	Introduction of cloud technologies, the Internet of Things, voice assistants, and artificial intelligence.
2020s	Preparations for a new system update.

Source: compiled by the author based on: I. McCue (2020), J. Goldston (2020), G. Golik-Górecka (2022), J. Robertson et al. (2022), N. Abdelwahed & B. Soomro (2023)

The need for the rational use of resource potential emerged when enterprises began employing a diverse set of resources – human, technological, financial, etc. – to achieve their objectives. Simultaneously, as the volume of available resources grew, so did the threats of mismanagement (irrational or misdirected use, abuse of authority, focusing on less important objectives during work, etc.). Therefore, developing an integrated system for managing the enterprise's resource potential became a key task. With the global expansion of innovation and technology (creation and spread of the Internet, the popularisation of various online tools and digital control and monitoring systems), ERP systems have improved. This process continues today – it is projected that with the further spread of artificial intelligence technologies, the system's functionality will become even more universal and flexible (Goldston, 2020).

The beginning of the 21st century marked the intensification of large-scale digitalisation of nearly all state and societal processes. Pandemic restrictions caused by the outbreak of the COVID-19 coronavirus forced both citizens and enterprise managers to seek new ways to achieve their goals and fulfil enterprise tasks. Under the new world order, new opportunities have emerged, which in turn give rise to new risks. Enterprises, dealing with new aspects of rapidly evolving modern life in the context of globalisation, must adopt innovative solutions, systems, and approaches for identifying and assessing risks in the planning process (Yao, 2023). Currently, the most commonly used systems are hybrid ERP types, which combine local and cloud (Internet-based) technologies. For example, ERP solutions implemented by

global corporations such as Google and MySpace were examined. Their operations were based on a comprehensive combination of both local (traditional methods of enterprise performance evaluation – reports, analytical memos) and digital tools (use of ICT systems for evaluation and monitoring – virtual platforms, artificial intelligence technologies, smart systems, etc.) (Patel, 2024).

In the case of Google, several factors can be noted. Corporations with a significant share of technological, informational, and innovative components in their operational structure have more favourable conditions for implementing risk management elements in resource management. Specific efficiency indicators of ERP before and after implementation of decision-making system components were not investigated in this study. However, through comparative analysis with other corporations in the same sectors, it can be concluded that the more effectively ERP elements are implemented into the production process structure, the higher the corporation's indicators in various sectors – finance, human resources, technological capabilities. This is primarily due to a clear plan for identifying, monitoring, counteracting, and minimising risks as a phenomenon potentially affecting institutional operations.

Google's corporate policy does not allow disclosure of information related to its use of specific ERP systems – to minimise data leaks and industrial espionage. However, open sources confirm the company's use of financial instruments such as SAP S/4HANA Cloud, SAP Ariba, and SAP HANA Enterprise Cloud, which are cloud technology tools with multi-level protection of personal data and financial operations

(“What ERP does Google use?”, n.d.). The effectiveness of these tools is supported by financial calculations: the global cloud ERP software market grew to USD 5.2 billion and is projected

to reach USD 12.3 billion by 2032, which testifies to the high efficiency of these tools within ERP system infrastructures (“Google Workspace ERP software market”, n.d.) (see Table 5).

Table 5. Advantages, risks, and potential solutions to unresolved issues through the implementation of innovative solutions and new technological tools in enterprise practice

Technology	Advantages	Risks	Key Solutions
Cloud-based ERP system	It helps to increase the productivity of the production process, speeds up logistics and management decision-making. Increase efficiency and reduce costs. Quick access to any information from any location. Ensures transparency of operational processes. Employees become more technologically integrated, interconnected, and their level of communication increases. Improving the quality of customer service (if any).	The threat of data leakage. Incorrect use of planning tools can cause a system error. The need to adapt personnel to new technological conditions of the system. The risk of entering incorrect data into the system (intentionally or accidentally).	Increase work efficiency by combining the functionality of a cloud-based ERP system and artificial intelligence to cross-check and increase the volume of tasks performed. The combination of artificial intelligence and the Internet of Things will allow you to automatically monitor and respond to all decisions of the combined systems. The combination of artificial intelligence and the Internet of Things in the structure of a cloud-based ERP system under human control will allow all processes to be managed regardless of the decisions made at the level of the computer code of individual components.
Internet of things	A well-structured, adaptive and logically connected system of tools for exchanging data with a wide range of devices and instruments. Large volumes of data collected and transmitted. Real-time monitoring of processes.	The risk of data leakage.	
Artificial intelligence	Optimisation of decision-making processes with minimal risks. Performing monotonous operations without the involvement of the human factor. Full automation of all processes. Minimising the time required to make the most optimal and logical decisions.	The risk of changing the mood in the team due to the active integration of technology. More advanced and logical technology solutions reduce the need for human presence in the production process. Personal rejection of smart machines in society. The threat of a critical error, a failure in the system’s core code that threatens the existence of all mankind.	

Source: compiled by the authors based on: K. Szuper & K. Wołoszyn (2020), J. Robertson *et al.* (2022), C.-S. Chirvase & A. Zamfir (2023), J.V. Barraza de la Paz *et al.* (2023)

At present, the most effective technological tools for addressing issues related to strategic planning of enterprise activities based on its resource potential are the use of cutting-edge innovative means – Internet technologies, digital systems, and online tools. For instance, cloud technologies allow for a significant reduction in the time from the proposal of an idea for developing a specific process or product to its actual implementation as a final result. The Internet of Things has become a practical tool for handling

large volumes of data, enabling remote control of information arrays, optimising workflows, and freeing certain resources for other tasks. Artificial intelligence is indispensable in addressing a large number of interrelated critical tasks simultaneously, especially within logistic, technological, and other interdependent chains.

However, it is worth emphasising that this toolkit is most advantageous in practice for enterprises with a pronounced innovative component in their production processes (e.g.,

technology companies, corporations involved in manufacturing equipment, software, information systems, etc.). Enterprises in the food industry, the social sphere, as well as construction and culture, have a lesser need for intensive integration of innovative systems. Nonetheless, the implementation of modern solutions into the workflow provides a significant competitive advantage within their respective sectors. For example, in the early 21st century, the social network MySpace was a popular communication platform. However, with the development of Internet technologies and the emergence of new online communication tools, the company clung to outdated practices, resisting the shift to new digital standards – in particular, failing to adopt artificial intelligence tools for processing search queries and encrypting data. Consequently, MySpace began to lose popularity, ceding its leadership to platforms like X (formerly Twitter), which, unlike MySpace, actively incorporated the latest technological tools into their development strategies (Shylkouskaya, 2024).

The most profitable companies in 2024 – the energy corporation Saudi Aramco, the investment company Berkshire Hathaway, and the information corporation Alphabet Inc. – focused their operations primarily on the use of cloud technologies and innovative technological solutions in the digital space to address security issues and maximise the use of resource potential. Their net profits (in billions of dollars) were as follows: Saudi Aramco – 113.41; Berkshire Hathaway – 106.9; Alphabet Inc. – 94.3. Key financial performance indicators – revenue, profitability, and return (in billions of dollars) – were as follows: Saudi Aramco: revenue – 494.54; profit – 113.41; return – 180.44; Berkshire Hathaway: revenue – 369.89; profit – 106.88; return – 102.61; Alphabet Inc.: revenue – 339.86; profit – 94.27; return – 202.74 (Derkach, 2024).

In analysing dynamic changes, it is worth noting the rate of transformation in profitability indicators. Saudi Aramco's petroleum trade volume in 2024 reached 7.3 million barrels per day, which is a 7% increase compared to 2023. At the same time, its revenue in 2023 dropped to a record low of 30 billion dollars (a 30% decline), although in 2022, the company's annual profit amounted to 161 billion dollars (Largest

companies by marketcap, n.d.). Berkshire Hathaway in 2024 recorded a record profit of 369.89 billion dollars, almost double that of the previous year (Palyvoda, 2024). Alphabet Inc.'s revenue rose from 83.47 billion dollars at the end of 2023 to 94.3 billion dollars in 2024 (Annual revenue of Alphabet..., n.d.).

Having analysed the financial indicators of the world's three most profitable companies, it may be concluded that, in general, the full-scale implementation of ERP system elements – which are based on process innovation through the introduction of modern digital tools and mechanisms into technological, economic, logistical, human and other functions – is contributing to a trend of annual growth in financial stability, performance, and the adoption of new approaches to achieving business objectives. The forecast for this dynamic remains relevant.

In examining the dynamics of these processes and global trends, the following factors are expected to be implemented into the development strategies of these enterprises in the near future. A common feature of these future perspectives is the comprehensive digitalisation and innovation of production processes and business model planning, including: the expansion of artificial intelligence functionality at all stages of strategic planning; the digitalisation of financial operations (via online tools); continued adoption of hybrid work modes for employees (offline-online); the growth of start-up project creation within existing corporations; a prioritisation of cybersecurity and total protection of personal data.

The Role of Risk Assessment in Utilising a Company's Resource Base

For the harmonious and successful development and functioning of any enterprise, it is crucial to adequately assess its entire available resource potential and to identify, at early stages, possible risks and threats to the performance of its functions. Among the most serious risks to the sustainable operation of enterprises are the following: frequent changes in the country's regulatory and legal framework; volatile exchange rates; political, social, and other challenges emerging in society; Overall instability and the inability to engage in long-term forecasting due

to outbreaks of armed conflicts across various continents (Sorin & Anca, 2020; Krupskiy *et al.*, 2024). Despite being among the most relevant and widespread in enterprise activity, such types of threats are difficult to detect at early stages, and it is equally challenging to take necessary steps to minimise their consequences

or to eliminate the risks altogether. Therefore, one of the most essential stages in planning activities within the strategy for utilising an enterprise's resource potential is the risk assessment process, which involves the systematic application of a risk identification and mitigation algorithm (Table 6).

Table 6. Specifics of risk identification in developing a strategy for utilising the enterprise's resource potential

Step	Description of Activity		
1	Search for risks		
2	Identifying risks		
3	Identifying risks		
3.1	Specifying risks: factors that contributed to their occurrence (internal and external).	Grouping of risks: distribution by probability of occurrence; directions of impact; intensity and duration of consequences; probability of minimising the impact.	Description of risks: identification of the primary source of occurrence; classification of causes (characteristic conditions) of occurrence.
4	Risk analysis		
5	Risk assessment		
6	Modelling future risk development		
7	Monitoring of risk indicators		
8	Selecting a strategy to avoid or minimise risks		

Source: compiled by the authors based on: V. Baldyniuk (2023), Y. Chen (2023), J. Nahar *et al.* (2024)

In the process of developing a strategy for utilising an enterprise's resource potential, the likelihood of various types of risks arising is of critical importance for planning future operations. It is essential, first and foremost, to identify all potential risks that are typical for the enterprise in accordance with its specific field of production. For enterprises operating in the food sector, key risks include the disruption of logistical chains, outbreaks of disease, restrictions on movement due to epidemiological conditions, climate change, and so forth. Consequently, the enterprise develops its growth strategy with alternative ways of achieving its objectives in mind (e.g., transporting finished products by rail instead of by road, or temporarily relocating production facilities to other sites with more stable epidemiological and environmental conditions). If, however, the nature of the enterprise's operations does not permit a relatively equivalent replacement of traditional processes, it seeks to use all available tools and mechanisms to minimise the negative consequences of the most critical threats.

By adhering to this algorithm for identifying and mitigating risks during the development of a strategy for utilising the enterprise's resource base, the following positive outcomes can be achieved: a reduction in expenditure (by avoiding or minimising unforeseen costs for standard procedures, which may otherwise lead to even greater additional expenses); improved safety standards (early forecasting of potential risks enables avoidance of unnecessary actions, such as sharing data with third parties when not strictly required for the enterprise's operations); and the reinforcement of a positive corporate image (effective risk management leads to more successful and efficient execution of the enterprise's tasks and responsibilities, thereby making it a more attractive partner for investors and entrepreneurs alike).

Furthermore, forecasting risks and responding to them in a timely manner lays the foundation for the enterprise's long-term sustainable development and ensures the reliability of transport and logistical routes. In addition, the search for, identification of, and response to

risks stimulates the innovative, intellectual, and material potential of the enterprise. These factors underpin the development of a competitive level of performance, whereby the enterprise, while leveraging its resource potential and accounting for possible risks, follows a relevant and effective strategy for its development.

Risk assessment is generally conducted using two approaches: quantitative and qualitative analysis (Mohonko & Trokhymchuk, 2024; Hasan *et al.*, 2024). The former may involve mathematical formulas, specific calculations, and model or standard comparisons to determine specific indicators in various areas of enterprise activity. This method is most relevant for evaluating risks in financial operations, balancing profits and expenses, and conducting audits of an organisation's economic performance. The latter – qualitative analysis – relies on expert opinions, facts, historical analogies, and state standards. This approach is optimal for assessing risks when evaluating candidates for positions within the enterprise or forecasting future actions regarding specific issues.

There are also several types of responses enterprises may adopt in relation to potential risks. One such response is risk avoidance, whereby an enterprise chooses a strategy that entails refraining from activities that might result in adverse outcomes. This implies that the company prefers to forgo potential profit opportunities rather than face possible losses—for example, closing a branch or refusing to expand operations. Alternatively, an enterprise may act to reduce the likelihood of risk occurrence. This involves continuing its usual operations while taking proactive steps to lessen the impact of potential risks or reduce their probability. For instance, a company may decide not to update a product line or its design but heavily invest in quality control and data protection.

A particular case is the practice of risk-sharing. Here, the enterprise continues to operate normally but engages a third party – typically a specialised organisation – to absorb the adverse effects of a potential risk event. This third party bears the main financial burden. A direct example of this approach is corporate insurance, where the insurer serves as the third party. Another risk response strategy is risk acceptance.

The enterprise acknowledges the potential risk but continues to act according to its development strategy. If adverse conditions arise, it responds in accordance with the situation and adapts to internal and external trends. For example, launching a new production line may be risky but also holds promise. In this case, the enterprise proceeds without constraints or third-party involvement, relying solely on the current context.

Risk Management in Enterprises in Ukraine

In Ukraine, the issue of developing a strategy for the utilisation of enterprises' resource potential while accounting for all possible risks remains highly relevant. In the context of ongoing military operations, economic upheavals, and the widespread destruction of logistical routes, the number of risks continues to grow, and enterprises find it extremely difficult to operate stably under such conditions without thoroughly revising existing approaches and adapting to the realities of the current situation. The risk of the war continuing into 2025 and 2026 significantly impacts the production capacities of the vast majority of Ukrainian enterprises – in such circumstances, long-term strategic planning becomes virtually impossible. Mobilisation measures directly affect the preservation of domestic enterprises' resource potential, particularly their labour and professional resources. In conditions of a limited or insufficient workforce, the ability of enterprises to perform their functions is significantly hampered.

The International Organization for Standardization has developed a standard for effective enterprise risk assessment – Risk Management (ISO 31000:2018) (ISO 31000:2018 – international standard, 2018). Based on this, Ukraine has developed DSTU ISO 31000:2018 Risk Management. Principles and Guidelines (Order No. 446 “On the Adoption and Cancellation of National Standards, Adoption of Amendments to the National Standard”, 2018), according to which entrepreneurial activity is currently conducted in the country. Specifically, the work is carried out following standardised scenarios for shaping the business landscape, modelled on the practices of European companies.

In the spring of 2024, the Ministry of Economy of Ukraine presented a forecast of potential

risks for the development of the entrepreneurial sector in the country for the period 2024-2027 (Issue "Ukraine: Recovery...", 2024). This forecast was based on such factors as the likelihood of a specific risk materialising and the consequences of its impact on the economic and financial sectors of the country. According to the findings of the study, the main threat and key risk to all sectors of entrepreneurial activity in Ukraine, without exception, is the "Continuation of war on the territory of the state". This was the most likely risk for 2024 and remains so for 2025 and 2026. By 2027, the probability of this risk occurring is expected to decrease by approximately 50% (Table 7). Other risks identified include general economic instability and uncertainty; risks associated with a contentious geopolitical situation; the threat of cybercrime; unforeseen legislative changes; climate change (environmental

threat); the rapid development of new technologies and artificial intelligence; the destruction of transport and supply logistics routes; the transformation of consumer and client demands and needs; uncontrolled growth of competition; and risks associated with social instability.

The risk of logistical disruptions is particularly critical for food industry enterprises – due to the breakdown of established transport routes, entire workflows are dismantled. For agricultural enterprises, the restrictions associated with the occupation of territories pose the risk of losing land rich in fertile soil, such as agricultural fields. As a result of being unable to grow certain crops, such enterprises suffer significant financial and production losses. A decline in financial support from partner countries could be particularly dangerous for socially oriented enterprises.

Table 7. Risk assessment for Ukraine for the period 2025-2027, %*

Risk	Probability of occurrence		
	2025	2026	2027
Continuation of the war	13	9	6
Restrictions related to the occupation of territories	12	9	8
Decrease in financial revenues from other governments	13	11	11
Regular mobilisation	10	4	4
Increased migration, brain drain	12	12	10
Negative changes in legislation	9	6	6
Blockade of logistics routes	9	10	11
Slowdown in integration processes	7	6	6
Inflation	7	7	6
Signing a peace agreement on unfavourable terms	8	9	9
Other (environmental issues, social inequality, threat of artificial intelligence, etc.)	6	6	6

Note: * – probability of risk occurrence during a specific period

Source: compiled by the authors based on Issue "Ukraine: Recovery..." (2024)

Analysis of Table 7 reveals several important trends regarding the assessment of risks for Ukraine in the period from 2025 to 2027. The highest risks in 2025 are the continuation of the war and the reduction of financial inflows from foreign governments (both at 13%), indicating their high probability. Significant threats also include restrictions associated with the occupation of territories, as well as increased migration and "brain drain" (both at 12%), which point to serious socio-economic challenges. At the same time, certain risks are gradually decreasing. Notably, the risk of further mobilisation

is expected to fall significantly – from 10% in 2025 to 4% in 2026-2027 – which may reflect a reduced need for additional military resources. The risk of negative legislative changes is also expected to decline from 9% in 2025 to 6% in 2026-2027, indicating projected stabilisation of the legal environment. However, some risks remain stable or even increase. For instance, the risk of logistical blockades rises from 9% in 2025 to 11% in 2027, potentially signalling economic and geopolitical difficulties. Similarly, the risk of a peace agreement being signed on unfavourable terms increases from 8% in

2025 to 9% in 2026-2027, reflecting growing concerns about future diplomatic negotiations. Other threats – such as environmental issues, social inequality, and the development of artificial intelligence – remain stable at 6% throughout the forecast period, which indicates their ongoing relevance.

Considering the data from Table 7, one can assess the potential impact of each risk on business operations. The prospect of continued military conflict in the country is undoubtedly a major negative factor and the primary risk for any professional business activity, as war precludes stable development. Territorial occupation, migration processes, the emigration of skilled personnel, and the decline in external financial support are also key elements posing direct threats to the enterprise's resource capacities- human (staff), production (territory), and economic (finances). These risks are expected to exert a relatively strong influence and carry high probability up to 2027. Other risks – such as logistical disruptions, inflation, and a disadvantageous peace agreement – also contribute to instability in business operations. However, provided that other, more serious threats are absent or unlikely, the impact of these risks may be comparatively minor and could be mitigated through comprehensive solutions: reforming transport and logistics policies, redirecting cooperation to other partners, or shifting towards more cost-effective means and tools essential for enterprise operations.

Examining the key elements in the process of risk assessment in the development of a strategy for the use of an enterprise's resource base reveals certain features, core characteristics, and both strengths and weaknesses. A comprehensive approach to assessing likely risks in the course of an organisation's regular activities became relevant as early as the mid-20th century, when Western countries began developing corporate risk management systems closely linked to enterprise resource planning. The importance of operational response and adequate reaction to risks across various sectors of enterprise production processes is determined by the need to adapt to new realities. The application of all available new tools and mechanisms for identifying, tracking, and neutralising risks

contributes to the harmonious development and effective functioning of the organisation.

To improve the effectiveness of risk identification and assessment during the development of a strategy for using the enterprise's resource potential – and to intensify the outcomes of counteracting these risks – a specific set of practices and decisions is proposed. Engaging representatives from different departments, sectors, and divisions (within a single enterprise), as well as specialists from various fields (within the same area of activity), in the risk assessment process will help bring together diverse viewpoints and ideas, thereby increasing the likelihood of selecting optimal solutions to problems caused by specific risks. Furthermore, uniting personnel within a single enterprise can have a positive effect on the collective as a whole – this factor may minimise the likelihood of risk emergence within the workforce in the future (as staff are an integral component of the enterprise's resource base).

Risk assessment must not be a one-off act carried out at a specific point in time. This process should be ongoing and continuous, as only under such conditions can all production processes be systematically monitored and the status of all aspects of the enterprise's resource support be effectively controlled. Through continuous analysis, it becomes possible to introduce timely adjustments to work processes, update and optimise systems, and address problem areas. Moreover, constant risk monitoring is linked to the review of the business environment, which positively influences the enterprise's overall development and supports the construction of a long-term business strategy.

The active integration of new information and communication tools into business processes and risk detection algorithms is a crucial element of business strategy development – especially during crises associated with post-pandemic economic recovery and the full-scale war launched by Russia against Ukraine. The implementation of new risk assessment mechanisms allows for quicker and more efficient responses while conserving such strategic resources as time and finances. Equipping enterprises with software aimed at risk detection and mitigation is a near-term priority, as such solutions can

substantially enhance the quality of results obtained from the assessment of large volumes of data – financial and economic reports, project materials, and business case documentation. The use of specialised software, as well as artificial intelligence technologies and personal assistants, helps reduce human influence on technological processes, thereby minimising the risk of unforeseen errors and threats.

DISCUSSION

Having examined the issue of assessing potential risks in the development of a strategy for utilising an enterprise's resource base under crisis and post-crisis transformations, as well as through the lens of rapid implementation of new information and communication technologies, it can be concluded that this issue has been widely explored by many experts and researchers across various sectors and disciplines.

This study emphasised that the system for utilising an enterprise's resource base is neither static nor standardised but rather dynamic and variable – depending on the type of enterprise, its field of activity, and the internal structure of the enterprise itself, which is often unstable and particularly vulnerable to risk exposure. A similar perspective is shared by M. Al-Amin *et al.* (2023), who describe the resource utilisation system of an institution as one of the prerequisites for the sustainable development of a company as a competitive force in the entrepreneurial environment. However, this study highlighted that the key practical advantage of such a system lies in the possibility of implementing its individual parts and components, which proves to be quite effective and productive.

The issue of the lack of clear definitions for the terms “enterprise resource potential”, “risk”, and related concepts in the literature was raised in this work. It was noted that interpretations may vary depending on the country and its financial and economic status. T. Talasi & L. Seymour (2022) hold a similar view, drawing parallels when comparing enterprises from countries with differing levels of economic development – where the higher the financial and economic indicators of a particular company within a given state, the broader the range of resources at its disposal, and vice versa. Nevertheless, this

study placed greater emphasis not on the state economy shaping the development level of an enterprise, but on the notion that the operations of such enterprises contribute to the overall well-being of the state in which they operate.

Depending on the analysis of the enterprise's area of activity and the key component of its resource potential – i.e., the one most applied in achieving its objectives – the nature and orientation of its operational strategy are determined. This idea aligns with the view expressed by N. Zumaľ & N. Sibindi (2023) concerning the classification of risks across companies in various fields of activity and the subsequent strategic planning depending on the analysed risks. These authors argued that risks related to personnel or technical staff may, in some cases, be disregarded, whereas those connected to production or logistics processes must not. This study, however, focused on the standpoint that all operational areas of an organisation are important and that all probable risks must be assessed and, where possible, minimised.

Without the targeted integration of digital technologies and online services into the operations of industrial, economic, and other types of enterprises, it will be increasingly difficult to develop business activities and create competitive products in the near future. This conclusion, presented in the study, echoes the arguments of A. Taher *et al.* (2020), who regarded emerging technologies as a genuine achievement of the third millennium and referred to digital systems enabling enterprise management – particularly in terms of risk management optimisation – as the most effective tools for developing a new-format economy. Nonetheless, this study also examined information and communication technologies from a critical perspective, acknowledging their potential harm if misused, implemented unprofessionally, or misunderstood in terms of their purpose and functionality.

The article emphasised that various crisis phenomena of the early 21st century – economic downturns, the outbreak of the COVID-19 pandemic, and military conflicts – negatively impacted entrepreneurial activity in most countries, resulting in an overall deterioration of the state's financial and economic sector and unforeseen transformations in the industrial,

economic, and social domains. N. Abdelwahed & B. Soomro (2023) expressed very similar views, highlighting that the pandemic restrictions of the early 2020s caused unprecedented damage, particularly to industrial and manufacturing enterprises, since their development strategies had not anticipated a crisis of this scale and therefore lacked contingency steps to mitigate its effects. However, this study also noted that certain corporations – especially those based on digital and online technologies – managed not only to survive but also to thrive and consolidate their positions under new, constrained, and stressful external conditions.

This research stressed that organisations should implement dynamic online technologies and digital risk management systems to enhance their capacity for risk identification, analysis, and mitigation, as well as to enable timely responses and adequate countermeasures in line with established rules and regulations. Similar conclusions were drawn by Y. Patel (2024) and researchers A. Karpenko & N. Karpenko (2023), who argued that, to achieve their objectives, enterprise leadership must maintain organisational resilience, adopt proactive risk management, and foster a culture of interpersonal relations based on continuous improvement – by leveraging cutting-edge innovative solutions, mechanisms, systems, and tools. In addition, this study underscored the need for ongoing staff training and professional development to avoid risks related to interactions with new systems and software.

To intensify business activity and adapt companies to the stressful external conditions of the modern world, it is crucial to develop and maintain a robust theoretical foundation on this issue. This includes supporting research, shaping a consistent conceptual framework, and cultivating an understanding of the essence and content of risk management systems among all participants in economic activity. G. Sorin & E. Anca (2020) reached similar conclusions in their research, describing entrepreneurial activity through both practical and theoretical approaches, which they viewed as interdependent, with each derived from the other. However, this study placed greater emphasis on the practical dimension – namely, the achievement of set

goals and the minimisation of risks in operational processes – which was considered more significant than theoretical inquiry alone.

Beyond the implementation of objectives outlined in a company's development strategy based on its resource potential, this research emphasised the importance of thorough preparation when selecting such a strategy. If the action plan does not reflect the enterprise's real capabilities, successful growth becomes virtually unattainable. According to K. Alawatagama (2022), a comprehensive analysis that encompasses even the smallest elements of an enterprise's resource base should be the first step before beginning operations. Even seemingly neutral factors – such as office layout, temperature and humidity levels, and the staff's ability to communicate seamlessly in offline settings – must be taken into account.

In examining aspects of strategic enterprise development through the effective and optimal use of all available resources, while estimating the likelihood of various risks, several key factors can be highlighted. This topic is widely discussed at various levels of public and state governance, as the success of industrial and other businesses directly influences a country's sustainable development. Based on expert and specialist conclusions as well as the findings of this research, it can be concluded that the issue will remain relevant – owing to the ongoing need for theoretical and scientific justification of specific components of enterprise risk management systems within the context of the evolving global economy.

CONCLUSIONS

The enterprise resource planning system encompasses various concepts – such as “resource potential”, “resource base”, “entrepreneurial potential”, “risk”, and others – all of which are integrated into a single, logically coherent phenomenon, the essence of which lies in the development of a conceptual framework for the system of strategic planning of an enterprise's resource potential. An analysis of the most successful global corporations (such as Google and Meta) in terms of capitalisation reveals that their profitability stems from a comprehensive and balanced approach to developing their growth

strategy based on the entirety of their available resource base. This base comprises a broad array of components, including human capital, technological capabilities, financial resources, intellectual and innovation assets, and technological aspects.

The availability of specific resources within an enterprise contributes to the formation of a more extensive and flexible development strategy. Drawing on accumulated experience, as well as the effectiveness and quality of existing resources, a corporation is able to reduce the preliminary stages of strategy implementation (in particular, the stages related to risk identification and initial assessment) and move directly to minimising their adverse consequences. The global demand for systems that ensure a comprehensive approach to strategic planning in enterprises has been shaped by the historical development of risk management systems, which, at the beginning of the 21st century, began to rely on cutting-edge information and communication tools, digital systems, and online functionality. Innovative approaches to developing institutional planning strategies based on the latest technological solutions determine the extent to which an enterprise is prepared to respond to global development challenges, adapt

to emerging threats, and neutralise the negative impact of risks. For Ukraine, risk management within the strategic planning process for enterprise development is an especially urgent task. A key outcome should be the creation and implementation of strategies that enable domestic corporations to fulfil their objectives under conditions of crisis transformation brought about by military conflict, economic turbulence, labour shortages, and other challenges.

In order to enhance the relevance of the findings for future academic inquiry, it appears expedient to examine this area of economic activity at the enterprise level in the context of Ukraine's post-war recovery. Promising directions for further research include the analysis of how enterprises across various sectors (e.g., food, construction, and trade) utilise their existing resource potential during the adaptation process associated with the country's post-war recovery and the restoration of its economic framework.

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CONFLICT OF INTEREST

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Оцінка ризиків при розробці стратегії використання ресурсного потенціалу підприємства в сучасних умовах

Анотація. Раціональне використання ресурсів мінімізує ризики реалізації підприємством своїх завдань в умовах змін фінансово-економічної ситуації на глобальному рівні. Метою роботи було визначення ключових загроз у процесі планування стратегічного розвитку підприємства шляхом аналізу його потенціалу та обсягів ресурсної бази. Основними методами були системний аналіз (окреслені складові проблематики), та історичний (розглянуті етапи становлення та розвитку системи оцінювання ресурсного потенціалу підприємства). Визначено, що поняття використання ресурсного потенціалу

і аспекти, пов'язані з даними процесами, мають широке коло трактувань, що згруповані за характеристиками, особливостями та специфіками. У процесі аналізу діяльності компаній, таких як Google та MySpace, визначено що практика у розробці та використанні стратегій застосування ресурсної бази рядом корпорацій показує, що найбільш вдало та за призначенням даний підхід реалізується в компаніях переважно технологічного та інформаційного спрямування. У своїй роботі такі підприємства використовують всю наявну ресурсну базу (трудові ресурси, технологічні потужності, фінансові можливості, інноваційні знання, інтелектуальний наробіток). Визначено, що, базуючись на цих ресурсах, підприємство розбудовує стратегію розвитку, яка включає моніторинг наявних сценаріїв, планування стратегії, діяльність за стратегією, і дані процеси не відкидають варіанти обходу або відмови від одних етапів та долучення нових кроків до створення стратегії. Шляхом оцінювання тих чи інших ризиків (продовження бойових дій, посилення мобілізації тощо) було акцентовано вірогідність інтенсивності їх впливу на подальші тенденції з розвитку підприємницької діяльності в Україні. Встановлено, що для українських підприємств, які продовжують свою діяльність в умовах війни, проведення заходів з ризик-менеджменту, є надзвичайно важливим заданням, особливо в контексті пошуку альтернативних шляхів розвитку підприємства. Результати можуть бути використані як практичні напрацювання для наукових пошуків за темою

Ключові слова: економічна діяльність; капітал; система управління; інновації; цифрові інструменти



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Assessment of the quality of accounting information in financial and management reports of agricultural business enterprises

Abstract. The study aimed to assess the efficiency of using accounting information for making management decisions in agricultural enterprises, as well as to address the factors that affect the quality of financial and management reporting. The research methodology was based on an empirical approach and a combined analysis of publications covering the issues of digitalisation

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of accounting and the application of international financial reporting standards, as well as the use of software for automating accounting processes. The main results demonstrated that the quality of accounting information significantly affects the financial stability and competitiveness of agricultural enterprises. The study revealed that insurance is key for farmers in reducing risks. In 2024, payouts under the MeteoZakhyst insurance programme hit 231 million UAH, with an average reimbursement rate of 52%. The study determined that automation of accounting processes, implementation of international standards and staff training can significantly improve the accuracy, transparency and efficiency of financial reports. Using such programmes as Farm Management Systems and GeoPard can optimise accounting processes, reducing the probability of errors, improving the accuracy of financial data and increasing the efficiency of management decisions. At the same time, the study determined that there are significant challenges, including low employee skills and limited use of digital technologies in small businesses, which create difficulties for the implementation of the latest solutions. The conclusions confirm the importance of improving the quality of accounting information for the effective management of agricultural enterprises, especially in the context of a changing economic situation, high competition and global challenges such as climate change and volatility in financial markets. The practical significance of the study is determined by the fact that its results can be used by agricultural enterprises to improve accounting practices, increase the accuracy and transparency of financial statements, as well as to integrate the latest digital technologies and international standards to increase financial stability and competitiveness

Keywords: digitalisation; accounting; reporting; transparency; audit; budget; control

INTRODUCTION

The assessment of the quality of accounting information in the financial and management reports of agricultural business enterprises is conditioned by several factors that determine the importance of accurate, transparent and efficient accounting in the context of modern economic challenges. The agricultural sector is the backbone of the economy of many countries, including Ukraine, and has specific features that affect the way business transactions are recognised in accounting and reporting. The specifics of accounting in agricultural enterprises are related to seasonality, specific natural conditions, diversity of activities and market volatility. The accuracy and reliability of accounting information determine the effectiveness of management decisions, the ability to attract investments, forecast financial results and make strategic decisions for the development of agricultural enterprises. Due to globalisation and the integration of agricultural enterprises into international markets, ensuring compliance with financial and management reporting with international standards is becoming even more important.

Studies of the quality of accounting information in agricultural enterprises indicate the

importance of transparent accounting mechanisms for ensuring financial stability and efficiency of management decisions. C. Khadka *et al.* (2024) confirmed that the quality of accounting information directly affects the success of agricultural enterprises. However, the study identified gaps in the study of the impact of external economic factors and the integration of international standards in the accounting of agricultural enterprises, which require further research. Digitalisation of accounting in agricultural enterprises is an important element of the modernisation of business processes. N. Potryvaieva *et al.* (2022) studied the use of information technology to transform accounting processes in the agricultural sector of Ukraine, identifying factors that slow down this process, such as insufficient funding and low qualifications of employees. However, there is still a need to study the problems of providing rural areas with digital infrastructure and government support for digital solutions for agricultural businesses.

The importance of accounting information for the economic development of agricultural enterprises is obvious, in the context of strategic management accounting. M. Čavlin *et al.* (2022)

studied the importance of strategic management accounting for business decision-making, emphasising that its application can increase the efficiency of management decisions and contribute to the sustainable development of enterprises. The results of the studies demonstrated that strategic management accounting is necessary to assess market opportunities and threats, but there is still insufficient research on how its implementation can affect the adaptation of agricultural enterprises to changes in the economic environment. The impact of digital technologies on the effectiveness of these tools in the agricultural sector is one of the aspects that requires further study.

Financial statements are necessary for the assessment of the financial performance of agricultural enterprises. N. Krasnostanova *et al.* (2022) determined that the main indicators of financial stability are net working capital, the coefficient of autonomy, manoeuvrability and financial stability. They also note the absence of a unified methodology for assessing the financial condition of agricultural enterprises. The study also includes the need to improve financial reporting methods, especially concerning the assessment of profits of agricultural enterprises. Cash flow management is important for ensuring the financial security of agribusinesses, especially in the post-war reconstruction period. Y. Manachynska *et al.* (2024) identified the need to improve approaches to financial modelling to increase the investment attractiveness of agricultural enterprises. The study emphasised the role of actuarial accounting and reporting in attracting foreign investment. However, gaps that require further study include the integration of the latest digital technologies for more efficient cash flow management of agricultural enterprises.

Financial management in agricultural enterprises often faces problems related to insufficient funding and inefficient management practices. K.M. Mang'ana *et al.* (2023) investigated the impact of financial management practices on the performance of small and medium-sized enterprises in the agricultural sector in Tanzania. The study determined that working capital and financing management have a significant positive impact on the financial and

organisational efficiency of agricultural enterprises. However, accounting and financial reporting practices did not show a significant impact on the efficiency of these enterprises, indicating the need for further research on specific financial management practices.

Factors affecting the quality of financial reporting of agricultural enterprises are important for effective management. M. Đorđević *et al.* (2024) determined that profitability, debt level and audit of the company are significant determinants of financial reporting quality (FRQ). However, the results show that factors such as liquidity, board size, and audit timing do not have a statistically significant impact on FRQ. Issues that require further research include the relationship between corporate governance and financial reporting quality, as well as a deeper study of the impact of different types of audit firms on FRQ.

For the effective functioning of agricultural enterprises, it is necessary to create a system of accounting and analytical support. V.V. Grynychuk (2024) noted that this system should include financial accounting, analysis and internal control. The study demonstrated that financial accounting gives a complete picture of the financial condition of the enterprise, but for a more detailed analysis, data from management accounting is needed. The development of new methodological approaches to integrate management and financial accounting to make management decisions more effective is a problem that requires further research.

The study aimed to assess the effectiveness of the use of accounting information for making management decisions in agricultural enterprises and to identify factors that affect the quality of financial and management reporting. The objectives of the study were to analyse the main methods of assessing the quality of financial and management reporting of agricultural enterprises; to identify factors that affect the reliability of accounting information in agricultural business enterprises.

MATERIALS AND METHODS

The study was empirical and based on a combined approach to assessing the quality of accounting information in the financial and

management reports of agricultural enterprises. The main materials of the study included scientific publications, in particular (Poppe *et al.*, 2023; Abiri *et al.*, 2023; Fernando, 2024), which covered the issues of digitalisation of accounting, implementation of international financial reporting standards, use of analytical approaches to assessing the quality of accounting information and the impact of automation of accounting processes on the efficiency of management of agricultural enterprises.

The analysis of software used in the agricultural sector for accounting and financial management automation was emphasised. The study analysed such specialised software solutions as MASTER:Agro (n.d.), GeoPard (Independent Precision... n.d.) and Farm Management Systems (Farm Management Systems guide..., 2020). The study also covered the most widely used software solution, BAS Accounting (n.d.). As part of the study, a SWOT analysis of the quality of accounting information in Ukrainian agricultural enterprises was conducted, which identified the main strengths, weaknesses, opportunities and threats associated with the use of financial and management reports. The analysis incorporated aspects such as the level of automation of accounting processes, compliance with international standards (IFRS), the impact of digital technologies on reporting transparency, and the role of the human factor in financial data management. Based on the findings, practical recommendations were developed to improve the quality of accounting information in agricultural enterprises.

A comparative analysis of approaches to assessing the quality of accounting information in agricultural enterprises of Ukraine, Italy, the European Union, China and the United Kingdom was conducted. In particular, the approach used in Italy was studied, namely the Multi-Criteria Resilience Performance-Weighted Sustainability Composite Indicator (MRP-WSCI) method, which integrates environmental, economic and social indicators. The analysis of this approach assessed its acceptability for Ukrainian agricultural enterprises and the prospects for adaptation to increase the level of sustainable development. The study also analysed the formation of non-financial reporting in Ukrainian

enterprises, which includes compliance with the principles of sustainable development, assessment of labour conditions, investment in the regions, and implementation of International Financial Reporting Standards (2013). Challenges related to the need to digitalise processes and adapt to the environmental and social requirements of the European Union were studied. The use of Data Quality Assurance (DQA) tools to improve data quality in precision agriculture was analysed for the EU countries, particularly Germany. The introduction of environmental indicators, such as nutrient balance, and their impact on reducing costs and increasing the environmental sustainability of enterprises is considered. In China, an approach based on the use of Big Data and artificial intelligence (AI) to improve the efficiency of the agricultural sector is explored. The use of multidimensional indices was analysed to assess the quality of accounting information and the use of digital technologies to forecast resource requirements and optimise production processes. In the UK, the use of key performance indicators (KPIs) to assess operational efficiency in livestock production was investigated based on the Farm Platform data. The efficiency of using KPIs to improve the accuracy of management decisions and optimise costs was analysed. The results of the analysis were used to assess the state of accounting information and develop reasonable recommendations for improving its quality, which will help to improve management processes, increase transparency of reporting and competitiveness of agricultural enterprises.

RESULTS AND DISCUSSION

Accounting information is one of the main elements of management activities in agricultural enterprises, and its importance cannot be overestimated. In the agricultural sector, which depends on a variety of internal and external factors, such as weather conditions, fluctuations in raw material prices and end products, it is important to have accurate, up-to-date and detailed data to make the right decisions. The concept of accounting information covers the entirety of data on the financial and business activities of an enterprise that is used to prepare financial and management reports. This includes

data on revenues, expenses, liabilities, assets, and all transactions performed by the company.

Financial statements are based on accounting data and show the true financial position of a company. For agricultural enterprises, the reliability of accounting information is important, as changes in the market and natural conditions can significantly affect economic results. The accounting information system can be used to monitor the use of financial and material resources and assess the effectiveness of various methods of managing production processes. Financial and management accounting are important components of this system, as they can be used for the management of the enterprise to make strategic decisions based on reliable data (Abdollahi et al., 2020).

When preparing accounting information for agricultural enterprises, it is necessary to consider seasonality, weather dependence and the specifics of the use of natural resources. For instance, the agricultural sector has specific accounting for the costs of agricultural operations, purchases of seeds, fertilisers, fuel and maintenance of machinery and equipment. In addition, agricultural enterprises must consider the specifics of land valuation, crop yields, the value of biological assets and agricultural products, which are subject to market fluctuations (Brukhanskyi et al., 2015).

The introduction of modern technologies into accounting practices is an important step towards improving the efficiency of data processing and reducing the probability of accounting errors. Automation of accounting processes with the use of specialised software products significantly optimises internal processes of agricultural enterprises. Integrated modules for financial reporting, inventory, tax and payroll accounting, as well as adapted versions for agribusiness, can be used for the accounting of biological assets and the costs of production of finished goods at agricultural enterprises. This speeds up data processing and improves its accuracy, as financial and production indicators are automatically synchronised, reducing the probability of human error. Automated accounting systems significantly expand the capacity of enterprises to analyse and understand their financial performance through

the integration of specialised analytical tools. These systems enable the assessment of asset and capital profitability, helping to determine how efficiently the company's resources are being utilised (Akimova et al., 2024).

MASTER:Agro is a specialised software for automating accounting and management processes, enabling record keeping of production processes in crop and livestock production, effectively controlling the costs of growing biological assets, which is important for the agricultural business with its sectoral characteristics. The implementation of this system reduces errors associated with the lack of clear data organisation and real-time analysis (MASTER:Agro, n.d.).

GeoPard is used for automating land management and monitoring field operations, enabling more accurate analysis of farmland fertility. The system provides timely data updates and real-time monitoring, enabling managers to respond quickly to changes in business conditions, such as weather changes or fluctuations in market prices for products. This efficiency ensures more efficient management of production processes and minimises the risks associated with poorly informed management decisions (Independent Precision..., n.d.).

Farm Management Systems (FMS) are one of the most comprehensive solutions for automating agricultural accounting. They can be used to automate the accounting of sown areas, yields, crop costs and track the processes from planting to sale of products. Such software significantly improves the accuracy and efficiency of management decision-making, as data from different stages of production is automatically processed and transferred to the system for analysis. This not only reduces the probability of errors but also helps to identify deviations from the plan in a timely manner and adjust it (Farm Management Systems..., 2020).

Digital technologies that integrate various aspects of accounting processes enable agricultural enterprises to store and process large amounts of data in real time, which is important for adapting to the rapidly changing environment of the agricultural sector. As a result, automation not only reduces the possibility of errors but also promotes greater transparency

in financial reporting, which facilitates interaction with tax authorities and auditors. Ultimately, the implementation of such systems significantly improves the effectiveness of management decisions and ensures the stability of the

enterprise's financial processes. (Abiri *et al.*, 2023). Table 1 compares the main functions, approximate cost and advantages of various software products, such as MASTER:Agro, GeoPard Agriculture and Farm Management Systems.

Table 1. Comparison of software solutions for automation of accounting and management in agribusiness

Software	Main functions	Average cost (USD/pik)	Reduction of the probability of errors	Additional economic benefits
BAS Accounting	Accounting, human resources, warehouse logistics, sales and purchases, production processes, tax reports	300-500 USD (basic versions), up to 2000+ USD (enterprise solutions)	Control of duplicate documents, arithmetic checks, and automatic updating of legislative norms	Scalability, integration with external services, real-time analytics, modularity
MASTER:Agro	Management of crop and livestock production processes, accounting, analytics and reporting, data integration	500-1,000 USD	Elimination of manual calculations, minimisation of data discrepancies, standardised templates	Modularity, real-time analytics, integration with equipment, API connection
GeoPard Agriculture	Geodata analysis, seasonal monitoring of crops, creation of yield maps, data integration via API	Prices are not published (depending on scale and module)	Automatic detection of anomalies, elimination of data discrepancies, and prompt data updates	Scalability, increased yields, environmental impact, and reduction of excessive use of chemicals
Farm Management Systems (FMS)	Production process planning, operational management, crop monitoring, analytics and reporting, data integration	500-1,000 USD (basic packages), 3,000-10,000+ USD (advanced solutions), 15,000-50,000+ USD (custom development)	Standardisation of technological processes, control of duplication of operations, and elimination of discrepancies between departments	Scalability, risk prediction, and environmental optimisation through precision zoning

Source: developed by the authors based on Digitisation of the pig business (2019), Feodal FMS... (2023)

All of these software solutions have unique advantages, providing a selection of the most suitable solutions. BAS Accounting is the cheapest option with prices ranging from 300-500 USD, offering important features such as accounting, HR, warehouse logistics and automatic checks that reduce the probability of errors. It is suitable for small and medium-sized enterprises but may be limited for larger ones without upgrading to more expensive versions. Farm Management Systems (FMS) is the most expensive option, with prices ranging from 15,000 USD to 50,000+ USD, and offers production planning, crop monitoring, data integration, and environmental optimisation, making it suitable for large agricultural companies. GeoPard Agriculture, while not publicly priced, is optimal for large enterprises due to its po-

tent geodata analysis, increased yields, and reduced chemical costs. For medium-sized businesses, MASTER:Agro, priced from 500 USD to 1,000 USD, is the best choice due to its modularity, real-time analytics, and integration with equipment. All the above software solutions automate routine operations, reduce costs, improve data accuracy and optimise resources, which helps to increase efficiency and competitiveness in the market.

Furthermore, accounting information is essential for attracting investment in agricultural enterprises. Investors and lenders rely on reliable and transparent financial statements when assessing the potential of an enterprise. This is especially relevant for agricultural enterprises, as many of them require large investments in production development, improvement of

technical facilities or increase of sown areas. High-quality accounting information, its transparency and accuracy attract financing from both the government and private investors. For instance, companies that keep records following International Financial Reporting Standards (2013) can provide greater credibility to their financial statements, which is a key factor in attracting investment. Over the period 2022-2024, Myronivsky Hliboproduct (MHP), which accounts for the following international financial reporting standards, raised UAH 14.8 billion to develop its business in Ukraine (MHP entered the TOP of the largest..., 2024). Compliance with international financial reporting standards increases the company's transparency, which reduces investment risks and increases investor confidence. Such financial transparency provides an assessment of the company's financial position and prospects, which is an important factor in attracting investment.

In turn, government investment programmes often require detailed and transparent financial reporting to assess the effectiveness of the use of public funds. This ensures that government agencies have greater confidence in enterprises, which attracts funding through grants, subsidies and other government support programmes. Thus, accounting information is of great importance for agricultural enterprises. It is the basis for managing financial flows, making management decisions, assessing the efficiency of resource use, managing risks and attracting investments. An important condition for its effective use is the introduction of modern technologies in accounting processes, as well as continuous improvement of data collection, processing and analysis methods.

The main tool for external users, such as tax authorities, creditors and investors, is financial reporting. It contains several key documents, including the balance sheet (statement of financial position), income statement (profit and loss), cash flow statement and statement of changes in equity. The balance sheet provides information about the company's assets, liabilities and equity as of a certain date, which can be used to assess liquidity and financial stability. The income statement shows the company's revenues and expenses over a certain period

and shows how profitable it is. The statement of cash flows shows the sources and uses of cash; this is especially important for agricultural enterprises, as cash flows vary depending on the season. The statement of changes in equity shows how the structure of equity changes, whether due to new investments or dividend payments. Notes to the financial statements provide additional information that demonstrates the specifics of accounting for biological assets of agricultural enterprises (Fernando, 2024).

Management reporting, on the other hand, is designed for managers, the primary users of this information. Its main task is to provide information that can be used for decision-making in operational management. The income statement, production cost report, resource efficiency report and budgets and forecasts are part of the package. The income statement provides information on financial performance over a certain period, which helps management assess the profitability and efficiency of production processes. The production costs report can be used to assess the costs of, among other things, crops, land cultivation, fertilisers, pesticides, machinery and fuel. The resource efficiency report can be used to assess how efficiently the company uses its natural, material and human resources to maximise productivity. Budgets and forecasts are important tools for planning and forecasting financial results, which enable management to adjust the company's development strategy promptly (Fernando, 2024).

The peculiarities of the agricultural sector, such as seasonality of production and dependence on weather conditions, require a specific approach to the recording of business transactions in accounting and the formation of information in reporting. Agricultural enterprises often face high costs at the initial stages of production (sowing, fertilising, cultivating land), while revenues from the sale of products come only after harvest. This creates a need for special accounting that considers seasonality and ensures effective cash flow management. The specifics of agricultural production in financial and management reporting can be used to accurately estimate costs and revenues at different stages of the production process and respond to market changes promptly (Guido et al., 2020).

Thus, the system of financial and management reporting in agricultural enterprises is key for ensuring effective management, controlling costs and revenues, as well as for planning and forecasting performance. The specifics of agricultural production and the use of modern technologies in accounting processes are necessary conditions for achieving financial stability and the successful development of agricultural enterprises.

Assessing the quality of accounting information is an important aspect of ensuring effective management at agricultural enterprises. The quality of accounting information significantly impacts making the right management decisions, which directly affects the financial results of the enterprise. In this context, there are key criteria for assessing the information provided in the form of financial and management reports. Each criterion has specific characteristics and significance, especially in the agricultural sector, where seasonality of production, dependence on weather conditions and fluctuations in market prices require objective and timely accounting of business transactions.

Reliability of accounting information is a key criterion. It ensures an objective reflection of all company operations, such as the costs of crops, cultivation of agricultural land, machinery, wages and other expenses. This is especially important for the agricultural sector, as incorrect accounting can lead to incorrect management decisions, which in turn can lead to financial losses. The second important criterion is the objectivity of accounting data. In the agricultural sector, where all production processes are seasonal, timely data updates are a prerequisite for making management decisions. To ensure effective planning and forecasting, information on inventories, costs, and revenues must be constantly updated in real time (Poppe *et al.*, 2023).

Information compilation is another important indicator that determines how well all aspects of a company's operations are covered. Crop types, yields, soil conditions, machinery efficiency and other factors are often a challenge in the agricultural sector. To get a complete picture of the company's performance, all these elements must be considered in the reporting.

For agricultural businesses, accessibility and simplicity of accounting information are essential. To make quick decisions, management must have easy access to data, especially when the weather changes, which affects production processes. In addition, the transparency of the company's operations depends on the information being available to auditors, tax authorities and other stakeholders.

Data reliability and security are vital for agricultural enterprises, as they may use credentials to make decisions about lending, attracting investment, or meeting regulatory requirements. Protecting credentials from unauthorised access and damage ensures that external organisations have confidence in the company (Boyko, 2018). Compatibility of accounting information with other information systems of the company is another important criterion. Agricultural enterprises should integrate financial accounting operations with information generated in management accounting on inventories, biological assets and costs to manage production processes. This ensures maximum efficiency and prevents duplication of data or unnecessary information processing costs.

Furthermore, the accounting information must be transparent and comply with all financial reporting standards, both nationally and internationally. One of the main national financial reporting standards in Ukraine is Order of the Ministry of Finance of Ukraine No. 73 "On Approval of the National Regulation (Standard) on Accounting 1 "General Requirements for Financial Reporting"" (2013), which regulates the basic requirements for the composition and presentation of financial statements. This standard ensures transparency and compliance of financial statements with national requirements. At the international level, the most important standards are the International Financial Reporting Standards (IFRS) (2013) developed by the International Federation of Accountants (IFAC). IFRS are the basis for financial reporting in more than 140 countries, and its main goal is to ensure transparency, comparability and understandability of financial statements. This simplifies comprehension by investors and other users of financial information, increasing confidence in operations in international

markets. Also important are International Accounting Standards (IAS), which are part of IFRS and regulate in more detail the processes of accounting and measurement of assets, liabilities and income in various sectors of the economy. This ensures confidence from investors,

partners and regulators, and reduces the risk of fraud or accounting errors (Shubina *et al.*, 2021). Table 2 provides a more detailed description of each of the criteria assessed when analysing the quality of accounting information in agricultural enterprises.

Table 2. Key criteria for assessing the quality of accounting information in agricultural enterprises

Evaluation criterion	Description	Importance for agricultural enterprises
Accuracy	Reflection of the real financial position of the company without errors and distortions	Minimises the risk of making wrong decisions and reduces the probability of financial losses
Relevance	Timely information updates to support real-time decision-making	Ensures timely response to changing conditions, such as weather or market price fluctuations
Completeness	Inclusion of all the necessary data for a complete assessment of the company's activities	Providing comprehensive analysis for planning and making informed decisions
Availability	Easy access and usability of data for end users	Increases the efficiency of management decisions and enables quick response to the needs of the enterprise
Reliability and security	Protecting credentials from unauthorised access and data storage	Ensures confidentiality and data protection, increases trust from external users
Compatibility	Integrate data between different accounting and management systems	Increases data processing efficiency and provides more accurate enterprise management
Transparency and compliance	Compliance of information with international and national accounting and reporting standards	Increases the level of confidence in the company on the part of investors and regulators

Source: compiled by the authors based on O.O. Boyko (2018)

Assessment of the quality of accounting information in agricultural enterprises is an important condition for ensuring effective management and achieving stable financial results. The accuracy, relevance, completeness, accessibility and security of data are the main criteria that determine the effectiveness of an enterprise's accounting system. The introduction of modern technologies and automation of accounting processes helps to significantly improve the quality of information, which in turn improves management, reduces risks and optimises the resources of agricultural enterprises.

Digitalisation and automation can significantly affect the economic performance of enterprises, especially in the context of accounting and agricultural production. The use of the latest technologies can optimise numerous processes, increase efficiency and reduce costs, which directly affects financial results. Automation of accounting processes reduces

operating costs, as routine tasks are eliminated and the need for accounting staff is reduced. Improved data accuracy through automated report generation and minimisation of manual errors leads to more stable financial performance. Reducing audit costs through standardised procedures and transparency of financial transactions helps to save resources. In addition, the use of AI and Big Data in agricultural production ensures effective yield forecasting, which contributes to better resource planning and increased profitability. Such technologies can reduce the cost of fertilisers and plant protection products, which has a direct economic effect. In sum, the integration of digital technologies into production and accounting processes leads to a significant increase in the economic efficiency of enterprises. Table 3 provides more detailed information on the specific effects of digitalisation and automation at enterprises.

Table 3. Effects of digitalisation and automation

Effect	Description	Impact on economic metrics
Reduced accounting costs	Reduce operating costs by automating accounting processes	Reduce costs by 20-30% by eliminating routine and reducing the need for accounting staff
Improving data accuracy	Automated report generation minimises errors	Increase in data accuracy by 40-50%, which provides stable financial performance
Reduction in audit costs	Standardisation of procedures and transparency of financial transactions	Reduce audit costs by 15-25%
Yield forecasting	Use of AI and Big Data for efficient crop planning	Improved resource planning, increased profitability of enterprises
Reduced costs for fertilisers and crop protection	Precise management of agricultural processes with the help of technology	Reducing the cost of fertilisers and crop protection products, increasing economic efficiency

Source: compiled by the authors based on S.V. Oneshko *et al.* (2023), O.O. Evseeva *et al.* (2024)

As shown in Table 3, the reduction of accounting costs has a significant economic effect, providing a 20-30% reduction in costs due to the automation of accounting processes and the elimination of routine operations. Improving data reliability can increase the accuracy of indicators by 40-50%, which ensures stable financial performance and is important for maintaining business stability. Reducing audit costs can save 15-25% due to the standardisation of procedures and transparency of operations, which also has a positive economic effect. Yield forecasting using AI and Big Data improves resource planning, increasing profitability. The use of digitalisation and automation of accounting and agricultural production processes at Kernel is a vivid example of how technology can significantly improve the economic efficiency of an enterprise. In particular, the introduction of the TransitHub system for automating grain logistics has significantly improved communication with carriers, queue management at elevators and ports, which has resulted in reduced cargo downtime and faster cargo handling. Precision agriculture, including the use of satellite data, drones and weather stations to monitor fields, covers 100% of the company's land. Thanks to the use of RTK (Real-Time Kinematic) signals, the measurement accuracy reaches ≤ 2 cm, which ensures accurate yield forecasting, minimising the risk of losses, and reducing resource costs through precise fertilisation only in favourable conditions. The implementation of the Microsoft Dynamics NAV 2018 ERP system automated accounting operations and document flow, which reduced the

time for document approval and reduced operating costs. AI algorithms are also actively used to analyse data from GPS trackers, sensors and weather stations in real time, which optimises production cycles. According to the company, these innovative solutions reduced costs by optimising logistics, fertiliser and energy costs, as well as increasing yields through precision technology and data analytics (Tarasovsky, 2024). When companies use modern technology, they can adapt to new market demands and continue to grow in the long term.

Accounting information is important for analysing risks, forecasting potential losses and developing strategies to mitigate negative impacts on agricultural enterprises. It can be used to monitor financial flows, control costs, and respond promptly to changes in the market or weather conditions. Accounting information can be used by farmers to reduce risks and financial losses, improve forecasting and effectively manage their resources.

Insurance is important for farmers in mitigating the risks associated with uncertainty in agriculture, particularly in the event of adverse weather conditions or other force majeure situations. As a result of the Meteorological Protection programme, farmers received a total of 231 million UAH in insurance payments in the 2024 season, the highest level of compensation since the programme was launched in 2016. The main crops covered by insurance payments in the 2024 season are corn and sunflower, with a total area of 335 thousand hectares and a compensation amount of 225 million UAH. Agricultural

producers insured sunflower and corn crops in 1,039 applications, including 1,033 applications with 99% indemnity and 386 with 100% indemnity. In the 2024 season, MeteoZahyst's coverage expanded by 88% to 502,000 hectares. Due to adverse weather conditions, the amount of compensation increased tenfold, and the average compensation rate was 52%. Almost 50% of the total compensation amount was paid to farms in Kharkiv, Donetsk, Zaporizhzhia, Dnipro, Kherson and Mykolaiv regions (Syngenta in Ukraine increased insurance..., 2024).

Automation of accounting processes and the introduction of specialised software solutions have a major impact on reducing costs and increasing the efficiency of agricultural enterprises. For instance, systems such as Farm Management Systems can reduce fuel and material costs by 15-20% by optimising equipment routes and efficient resource planning. The use of GeoPard Agriculture to analyse NDVI indices and early detection of stress zones in the fields reduces crop losses by 10-15% (Rubtsova et al., 2021). In addition, automation of reporting through electronic document management reduces the risk of errors in financial statements by 30-40%, which ensures accuracy and transparency of accounting (Agrarians will receive state support for insurance..., 2020).

Price forecasting and data analysis are important aspects of risk management in the agricultural sector. Platforms such as AgriChain Farm integrate yield, market price and weather data to generate accurate forecasts, improved informed decision-making among farmers. According to Corteva Agriscience, insurance payments under index insurance programmes increased to 58 million UAH in 2020, stabilising income even under uncertain market conditions. In addition, integration with exchange platforms, such as GrainTrade, can be used for forecasting grain prices based on global trends, which is important for-profit planning and reducing financial risks (Agrarians will receive state support for insurance..., 2020).

Comparing the study by L. Marmul et al. (2023), it is possible to note that both studies highlighted the importance of financial results for agricultural enterprises, emphasising the need for reliable accounting and the use of

modern information processing methods to improve financial reporting. Studies also discussed the specifics of agricultural enterprises, such as seasonality and the need to account for biological assets. The main difference was that the study by L. Marmul et al. analysed the differences between national and international accounting standards and the need for their harmonisation, while this study focused more on the methods of accounting for financial results at the level of small and large enterprises, noting the lack of a single methodology.

Both studies analysed the implementation of sustainable accounting practices in agricultural enterprises. A.M. Alrowwad et al. (2022) addressed the theoretical aspects of accounting transformation to integrate environmental, social and economic factors. Similarly, this study emphasised the need to adapt accounting systems to the requirements of sustainable development, through the integration of environmental and social aspects. The main difference was that the study by A.M. Alrowwad et al. proposed a new accounting model based on theoretical strategies, while this study focused on practical recommendations for Ukrainian agricultural enterprises on improving accounting practices in the context of local economic and regulatory realities.

This study, as well as the approaches of K. Hushvakhtzoda (2023), analysed the improvement of accounting systems in agricultural enterprises, in particular, adaptation to the specifics of the agricultural sector, considering the seasonality of production and the impact of weather conditions. The study also stressed the importance of using modern information technology to automate accounting processes. The main difference was that this study focused on the theoretical aspects of improving financial reporting and the organisation of financial results accounting in Ukraine. At the same time, the study by K. Hushvakhtzoda analysed management accounting and the use of information systems for internal control of costs and financial results in agricultural enterprises in Tajikistan.

The presented study of the vision and research of V. Pasenko et al. (2024) converged in their focus on improving accounting systems in

agricultural enterprises, emphasising the importance of reliable accounting information for financial reporting. Both studies emphasised the role of information technology in automating accounting processes and reducing the probability of errors. In addition, both studies considered the need to adapt accounting systems to the specifics of the agricultural sector, to seasonal fluctuations and changing environmental conditions.

Quarterly reporting facilitates assessment of financial position, makes decisions on resource allocation, changes development plans and optimises costs. It includes various reports that can assess the situation and predict the company's future achievements. It is important that the reports are developed internally and are not published, which ensures maximum flexibility in adapting them to the needs of the company. The assessment of management accounts of agricultural companies includes several key elements. The analysis of income and expenses comes first. Agricultural enterprises should have a clear understanding of the costs of production and the sources of their income. This optimised costs, underlined ways to reduce unnecessary expenses and rendered the business profitable. Through this analysis, it is possible to identify which elements of production are the most costly and where savings can be made (Myniv & Khrystenko, 2024).

Second, an important aspect is the assessment of financial indicators. This includes the calculation of profitability, liquidity, turnover and other financial ratios, which can be used to assess the financial stability and solvency of the company. Analysis of financial indicators identified weaknesses in financial management and determined what measures should be taken to improve the situation.

Planning and budgeting are also important aspects of management reporting. Agricultural enterprises are characterised by high seasonality, so proper planning of production and financial flows is crucial for the stability of the enterprise. Budgeting can determine exactly what expenses are required for production and what income can be expected. Budgeting enables the company to plan the necessary investments and resources for future production cycles.

Analysis of investment efficiency is also an important component of management reporting. For agricultural enterprises, it is necessary to assess the efficiency of investments in land, machinery, equipment, and other resources used in the production process. The assessment of investments helps determine which ones are the most profitable and whether additional investments are required to develop production capacities. Management reporting also includes various tools for analysis and monitoring, including the company's balance sheet, income statement, and cash flow statements. These documents enable the management of an agricultural enterprise to get a clear picture of its financial position, structure of assets and liabilities, as well as opportunities for growth and expansion (Myniv & Khrystenko, 2024).

The budget helps agricultural enterprises to plan financial flows for the short and long term, which is critical for the stability of the enterprise in the face of economic uncertainty. An important element is also budget control, which ensures timely detection of deviations from the plan and adjustment of the strategy. SWOT analysis is also used as a tool for assessing management reporting. This method can be used to assess the strengths and weaknesses of an enterprise, as well as opportunities and threats that may affect its operations. SWOT analysis can develop a strategy that maximises the company's advantages and minimises risks. Management reporting tools and methods also include comparative analysis – a comparison of actual results with planned or previous periods. This method identifies positive or negative deviations, enabling timely corrective measures.

In general, management reporting is an important tool for effective management, optimisation of costs and resources, and strategic decision-making on the development of the enterprise. However, agricultural enterprises may face certain difficulties in their organisation, due to a lack of staff qualifications, insufficient automation of processes, as well as difficulties in implementing uniform management reporting standards.

In the future, to improve management reporting in the agricultural sector, it is important

to introduce new technologies that will help automate accounting processes, reduce errors and ensure the accuracy of financial data. In addition, it is important to improve the skills of employees in accounting and management to ensure the effective use of new management reporting tools. As a result, proper organisation of management reporting is crucial for increasing the efficiency of agricultural enterprises, their competitiveness and sustainable development in the context of global economic changes.

Assessment of the quality of accounting information in agriculture is critical for effective management and strategic development. However, several challenges in the agricultural sector impede the accuracy and efficiency of accounting processes. One of the main chal-

lenges is the seasonality of production, which creates difficulties in forecasting cash flows and estimating the value of output. In addition, agricultural enterprises often face challenges such as market volatility, changes in pricing policies, dependence on weather conditions and limited opportunities to integrate modern information technology into the accounting process. Another important problem is the lack of qualification of employees in the accounting departments of enterprises, which leads to an incorrect assessment of expenses, income and performance. This can significantly affect the financial stability and sustainability of an enterprise. In this situation, a SWOT analysis is an important tool for assessing the quality of accounting information, as shown in Table 4.

Table 4. SWOT analysis of problems and challenges in assessing the quality of accounting information in agricultural enterprises

Advantages	Disadvantages
<ol style="list-style-type: none"> 1. Use of modern information technologies to automate accounting processes at large enterprises. 2. Some companies have integrated accounting systems, which collect more data for analysis. 3. Focus on sustainable development and eco-oriented strategies in the accounting processes of agricultural enterprises. 4. Use of cost and revenue management software to improve accounting reporting. 5. Updating accounting policies in the face of changes in the agricultural market. 	<ol style="list-style-type: none"> 1. Low qualification of employees in accounting departments leads to errors and inaccuracies in accounting. 2. The lack of uniform accounting standards across many agricultural enterprises makes it difficult to compare results. 3. Seasonality of production makes it difficult to forecast revenues and expenses. 4. Insufficient use of analytical data to assess financial performance at many enterprises. 5. Low level of automation in small and medium-sized enterprises, which leads to high data processing time.
Possibilities	Threats
<ol style="list-style-type: none"> 1. Development of automated systems to facilitate the accounting process and minimise human errors. 2. Implementation of unified accounting standards to unify processes and improve data accuracy. 3. Upgrading staff skills through specialised courses and training, which will improve the accuracy and efficiency of accounting. 4. Investing in new technologies to automate accounting processes and improve financial performance analytics. 5. Increased access to international markets for agricultural enterprises, improving financial performance and introducing new accounting methods. 	<ol style="list-style-type: none"> 1. External factors, such as climate change or economic instability, may affect accounting processes. 2. Uncertainty in the regulatory environment may cause difficulties in adapting to new requirements. 3. Reduced efficiency of accounting systems due to seasonal fluctuations in production and sales volumes. 4. Volatility in agricultural commodity prices makes it difficult to forecast financial results and requires adjustments to accounting practices. 5. Inadequate management systems at small enterprises limit the possibilities for optimising accounting.

Source: compiled by the author based on R. Myniv & O. Khrystenko (2024)

After completing the SWOT analysis, it is necessary to create a set of recommendations that will help solve problems and maximise opportunities for improving the accounting information of agricultural enterprises. First, to ensure the reliability and comparability of

financial statements of agricultural enterprises, it would be advisable to introduce unified methodological approaches, the implementation of which will help avoid the issue of unreliable assessments of the financial condition of enterprises, as it will ensure the alignment

of financial data with international requirements, which is important for entering international markets.

Secondly, the automation of accounting operations is an important step. The introduction of modern software products to automate data collection and reporting will increase the efficiency of accounting departments and reduce the probability of errors. Automation will make accounting more convenient and transparent, avoiding the threat of human error, improve the accuracy of financial data and ensure the efficiency of accounting processes, reducing the time spent on processing information and reducing the probability of financial inconsistencies.

The third important area is the professional development of accounting staff. Providing accounting staff with training and education on the use of the latest standards and technologies will significantly improve the accuracy of accounting information. This will contribute to awareness of modern accounting methods and exercise more accurate control over the company's financial flows, which in turn will protect the weak aspects of accounting processes, reducing the risk of inefficient management of funds.

Another important recommendation is the creation of integrated information systems. The implementation of such systems will provide the automatic collection and processing of data from various sources and accounting subsystems, which will reduce the probability of errors and increase the efficiency of management and planning processes. Integration of such systems with external platforms will improve flexibility of response to changing market conditions, providing opportunities to adapt to new business realities and reduce the threats associated with insufficient flexibility in management.

Agricultural enterprises also need to incorporate external factors, such as climate change, economic instability or changes in legislation, which may have a significant impact on operations. To this end, it is necessary to develop mechanisms for monitoring and analysing such factors, which will provide timely adjustments to strategies and adaptation of accounting policies to new conditions. Implementation of an early warning system for possible changes in the external environment will help agricultural

enterprises to respond more quickly to risks and minimise their impact, which will contribute to the effective management of external threats.

Furthermore, agricultural enterprises should consider developing more flexible financial models that consider the seasonality of production and fluctuations in agricultural prices. This will improve planning of financial flows more efficiently, responding to changes promptly, and maintaining financial stability during periods of economic instability, which will reduce the risks associated with market fluctuations. Thus, the implementation of these recommendations will significantly improve the quality of accounting information in agricultural enterprises, increase management efficiency, ensure better transparency of financial processes and create a sustainable basis for development in a changing environment.

Assessment of the quality of accounting information is a key element for ensuring effective management of agricultural enterprises. Different countries apply different approaches to assessing this information depending on economic, technological and regulatory conditions. In Italy, the Multi-Criteria Resilience Performance-Weighted Sustainability Composite Indicator (MRP-WSCI) approach is used to assess the quality of accounting information in agricultural enterprises, which can be used to evaluation of the sustainability of farms through accounting data. This approach integrates environmental, economic and social indicators to assess the level of compliance of enterprises with the criteria of sustainable development. The ranking of farms according to the level of compliance with these criteria showed that none of the studied enterprises reached the level of "strong" sustainability, which indicates the need to optimise resource management and develop sustainable business models. The technological emphasis in Italy is on automating data collection, which improves the accuracy of analysis and provides more reliable accounting information. This improves cost, revenues and resource real-time tracking, which is important for adapting to changing market conditions and weather factors (Boggia *et al.*, 2022).

One of the key aspects is the implementation of International Financial Reporting

Standards (IFRS), which are the main standards for the preparation and presentation of financial statements at the international level. IFRS provide a unified approach to assessing the financial performance and financial position of companies, which makes reporting more transparent, understandable and comparable. These standards cover a wide range of issues, such as the identification and measurement of assets, liabilities, income and expenses, as well as the methods of their recognition and presentation in financial statements. IFRS increases the credibility of financial information, which is important for attracting investment, as investors and lenders can be confident that financial statements are reliable and meet international requirements. For Ukrainian agricultural enterprises, the adoption of IFRS has several important advantages: first, it improves investment attractiveness. The application of international standards improves the transparency of companies to foreign investors, which is relevant for raising capital and accessing international financial markets. Second, ensuring global comparability. Implementation of IFRS can be used to compare the financial performance of enterprises with other companies in the international market, which makes it possible to make strategic management decisions based on comparative analysis. Third, improved compliance with regulatory requirements. For Ukrainian companies seeking cooperation with international partners, the implementation of IFRS is mandatory to ensure compliance with the requirements of external regulators, such as the European Union and international financial institutions. Fourthly, reducing financial risks. The use of uniform international standards helps to reduce the risks associated with inaccurate or incomplete financial information, as IFRS provide a high level of detail and accuracy in the preparation of financial statements. Given these benefits, the adoption of IFRS is an important step for Ukrainian agricultural enterprises to improve their competitiveness, attract investment, and meet international financial reporting requirements (Zhuk *et al.*, 2020).

In EU countries, particularly in Germany, the focus of accounting information assessment is on the use of data quality assessment (DQA)

tools for precision agriculture. One example is the system developed by the Fraunhofer Institute for Experimental Software Engineering, which ensures 20% reduction in fertiliser use in line with the principles of the European Green Deal. This approach helps to reduce the negative impact on the environment and cut costs, making businesses more sustainable and environmentally friendly. EU countries are actively using digital solutions to improve the efficiency of agricultural processes. The introduction of precision farming and the use of environmental indicators, such as nutrient balance, can reduce the ecological footprint of agricultural enterprises while increasing their efficiency (Schroth *et al.*, 2023).

In China, multidimensional indices covering innovation, coordination, environment, openness and resource sharing are used to assess the quality of accounting information. China is actively integrating the latest technologies, such as Big Data and artificial intelligence (AI), to improve the productivity and environmental sustainability of the agricultural sector. These innovations increase the efficiency of resource management and lower production costs while improving environmental performance. The digital economy is an important factor in enabling China to transform its agricultural sector, increasing accounting efficiency and improving sustainability. Big Data and AI can be used for accurate forecasting of resource requirements and timely adjustment of accounting strategies to optimise production (Zhou *et al.*, 2024).

The UK is focusing on the use of key performance indicators (KPIs) to assess operational efficiency in livestock production. For example, a study by Farm Platform showed that properly selected KPIs can increase the information value of data by 3.5 times. The UK is actively using data analytics systems to optimise costs and improve accounting at livestock enterprises. The focus on cost optimisation and increasing the information value of data is important for improving the efficiency of agricultural enterprises in the UK, which contributes to the growth of competitiveness in the international market (Jones *et al.*, 2021). Table 5 shows a comparison of the experience of using accounting information quality assessment technologies in different countries.

Table 5. Assessment of accounting information in the agricultural sector: approaches, tools and results in different countries

Country	The focus in the evaluation of accounting information	Tools/Technologies	Results/Benefits
Germany	Application of data quality assessment tools for precision agriculture	Fraunhofer Institute for Experimental Software Engineering system	Reduced fertiliser use by 20%, improved accuracy of agricultural data, and environmental benefits
China	Multidimensional indices to measure innovation, environment and coordination	Big Data, Artificial Intelligence (AI)	Increased efficiency of resource management, reduced costs, improved environmental performance
Great Britain	Using KPIs to assess operational efficiency in livestock farming	Farm Platform	Increasing the information value of data by 3.5 times, optimising costs at livestock enterprises
Italy	Focus on environmental standards and digital tools for precision farming	Digital solutions for precision farming, environmental balance	Reduction of the environmental footprint of agricultural enterprises, improving sustainability and efficiency
Ukraine	Economic efficiency and integration into global markets through international standards	Adaptation to international standards to improve cost efficiency	Increase competitiveness in the global market and improve economic performance

Source: compiled by the authors based on A. Jones *et al.* (2021), C. Schroth *et al.* (2023), L. Zhou *et al.* (2024)

In general, different countries apply different approaches to assessing the quality of accounting information in the agricultural sector, depending on their economic, technological and regulatory conditions. European countries, such as Italy and Germany, focus on environmental standards and the introduction of digital tools to improve data accuracy. Ukraine, in turn, focuses on economic efficiency and integration into global markets through compliance with international standards. China is a leader in the use of digital technologies, including AI and Big Data, to transform the agricultural sector.

V. Fenyves *et al.* (2015) and the current study had a common focus on assessing the effectiveness of accounting information in agricultural enterprises. V. Fenyves *et al.* used the DEA method to assess the effectiveness, focusing on financial indicators, in particular, costs and revenues of enterprises. Instead, this study emphasised the importance of developing non-financial reporting that considers social and environmental aspects, which makes the approach more comprehensive. V. Fenyves *et al.* used statistical methods for financial analysis, while this study focuses on the automation of accounting processes and the use of digital platforms to improve accuracy and transparency.

The study by W.M. Muzari (2022) and the current article emphasised the importance of effective accounting for management decisions

in agricultural enterprises. W.M. Muzari highlighted management accounting, financial planning, and efficient use of resources, which optimises costs. At the same time, this study focuses on the development of non-financial reporting that considers social and environmental aspects to assess the sustainability of enterprises. In terms of technology, W.M. Muzari focused on classical financial accounting methods, while this study focuses on digital platforms and accounting automation to improve data accuracy and transparency. In addition, W.M. Muzari did not sufficiently analyse international accounting standards, while this study highlighted the integration of international standards such as IFRS to increase investment attractiveness.

B. Ouma & D. Nyambane (2023) emphasised the importance of using digital tools to collect and analyse data, which can improve the accuracy and efficiency of accounting processes. Similarly, this study notes that the automation of accounting processes and the introduction of modern digital technologies are a necessary step to increase the transparency and accuracy of accounting data. B. Ouma & D. Nyambane use a multi-criteria approach to assessing the efficiency of agricultural enterprises, which includes not only financial but also environmental and social indicators. This provides a more comprehensive assessment of the sustainability of enterprises and their impact on

the environment and communities. At the same time, this study focused on improving financial reporting, integrating international standards, and automating accounting processes to increase financial transparency. E. Kosta *et al.* (2023) had a common goal with the presented study – to improve accounting reporting in agricultural enterprises. However, E. Kosta *et al.* emphasised the practical challenges and shortcomings in implementing international accounting standards in less developed economies, while this study highlighted the impact of accounting reporting on the financial performance of enterprises in a more regulated environment, on stock markets.

The current study by V. Zamlynskyi *et al.* (2022) emphasised the importance of high-quality financial reporting for agricultural enterprises. Both studies emphasised the need to implement international accounting standards, such as IFRS, to ensure transparency of reporting and improve the efficiency of management decisions, which in turn attracts investments and increases the competitiveness of enterprises. V. Zamlynskyi *et al.* focused on the social and environmental aspects of sustainable development in the accounting reports of Ukrainian agricultural enterprises, focusing on corporate social responsibility and environmental requirements to increase investment attractiveness. While this study is more focused on the methodological aspects of implementing international standards on the problems of applying fair value for biological assets in the context of the lack of developed accounting practices.

The study emphasises the importance of accuracy and relevance of accounting information for agricultural enterprises, as it directly affects the efficiency of management decisions and financial stability. The introduction of digital technologies, automation of accounting processes, and the development of international accounting standards are necessary conditions for increasing the transparency and sustainability of agricultural enterprises.

CONCLUSIONS

Assessment of the quality of accounting information in the financial and management reports of agricultural enterprises is a key element

of effective management. The study confirms that the quality of accounting information directly affects the financial stability and competitiveness of enterprises. The introduction of international accounting standards, such as IFRS, contributes to increasing the transparency of financial reporting and strengthening the investment attractiveness of agricultural enterprises, which is especially important in the context of globalisation and integration into global economic processes.

The introduction of accounting information and digital technologies in the agricultural sector can significantly reduce financial losses, improve risk management and increase efficiency. The MeteoZahist programme provided farmers with the largest amount of insurance payments in 2024 – 231 million UAH. In 1,039 questionnaires, agricultural producers insured sunflower and corn crops; among them, 1,033 had 99% indemnity, and 386 had 100% indemnity. The average indemnity level was 52%. Automation of accounting processes using systems such as Farm Management Systems can reduce fuel and material costs by 15-20% by optimising the routes of machinery. In addition, the use of GeoPard Agriculture to analyse NDVI indices reduced crop losses by 10-15% through the timely detection of stress zones. Automation of reporting through electronic document management and standardised templates in MASTER:Agro reduces the probability of errors in financial statements by 30-40%. Forecasting and managing market prices are also important aspects of risk mitigation. Platforms such as AgriChain Farm integrate data on yields, market prices and weather conditions to create forecasts, predicting market trends with high accuracy and adapting the strategies. Thanks to the use of index insurance, according to Corteva Agriscience, insurance payments under index insurance programmes increased to 58 million UAH in 2020, stabilising the incomes of farmers.

A comparative analysis of accounting information quality assessment practices in different countries shows significant differences in approaches. For instance, in the European Union, in particular Germany and Italy, the focus is on the integration of digital technologies and ensuring compliance with environmental standards. In

the UK, key performance indicators are actively used to assess the financial condition of companies. China is focused on the use of artificial intelligence and Big Data to improve the accuracy of financial reporting, while Ukraine pays special attention to the adaptation of financial statements to international standards and the development of non-financial reporting. The experience of developed countries demonstrates that automation of accounting processes and implementation of modern analysis methods help to improve the efficiency of financial management, reduce risks and optimise the use of resources.

Further development of automated accounting systems and the introduction of digital technologies will improve the quality of accounting information and the efficiency of financial

management. At the same time, the limitation of this study is the insufficient coverage of the impact of environmental and social factors on the accounting policy of agricultural enterprises, which requires further research. Another promising area of research is a more detailed analysis of the impact of automated management systems on the quality of reporting and the development of recommendations for their optimal implementation in the activities of agricultural enterprises.

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CONFLICT OF INTEREST

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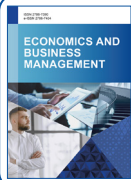
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Оцінка якості облікової інформації фінансової та управлінської звітності підприємств аграрного бізнесу

Анотація. Метою дослідження було оцінити ефективність використання облікової інформації для прийняття управлінських рішень в аграрних підприємствах, а також вивчити фактори, які впливають на якість фінансової та управлінської звітності. Методологія дослідження базувалась на емпіричному підході та комбінованому аналізі публікацій, що висвітлюють питання цифровізації бухгалтерського обліку та застосування міжнародних стандартів фінансової звітності, а також використання програмного забезпечення для автоматизації облікових процесів. Основні результати показали, що якість облікової інформації суттєво впливає на фінансову стабільність і конкурентоспроможність аграрних підприємств. За результатами дослідження виявлено, що важливим інструментом для аграріїв, який допомагає знижувати ризики є страхування, у 2024 році рівень виплат за програмою страхування «МетеоЗахист» сягав 231 мільйон гривень, а середній рівень відшкодування склав 52 %. Дослідження виявило, що автоматизація облікових процесів, впровадження міжнародних стандартів і підвищення кваліфікації персоналу можуть значно покращити точність, прозорість і ефективність фінансових звітів. Зокрема, використання таких програм, як Farm Management Systems та GeoPard, дозволяє оптимізувати процеси обліку, знижує ймовірність помилок, покращує точність фінансових даних і підвищує

ефективність управлінських рішень. Водночас виявлено, що існують суттєві проблеми, зокрема низька кваліфікація працівників та обмежене використання цифрових технологій на малих підприємствах, що створює труднощі для впровадження новітніх рішень. Висновки підтверджують важливість підвищення якості облікової інформації для ефективного управління аграрними підприємствами, особливо в умовах змінної економічної ситуації, високої конкуренції та глобальних викликів, таких як зміни клімату і нестабільність на фінансових ринках. Практичне значення дослідження полягає в тому, що його результати можуть бути використані аграрними підприємствами для вдосконалення облікових практик, підвищення точності та прозорості фінансових звітів, а також для інтеграції новітніх цифрових технологій і міжнародних стандартів з метою підвищення фінансової стабільності та конкурентоспроможності

Ключові слова: цифровізація; облік; звітність; прозорість; аудит; бюджет; контроль



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Development of human capital in the context of the emerging creative economy

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Abstract. The purpose of the present study was to analyse the role of human capital in the development of the creative economy, particularly through the introduction of innovations and the development of education. The research methodology included the analysis of strengths, weaknesses, opportunities, and threats, as well as the study of innovative programmes and educational initiatives. The principal findings of the study revealed that investment in education and technology is a major factor for the development of innovation in creative industries. The study of the AgroPortal, E-Agriculture, and AgroHub platforms showed their effectiveness in improving communication between farmers, suppliers, and consumers, which helps to optimise logistics processes and develop new business models for online sales. The study found that the introduction of digital technologies and the development of training programmes can markedly improve productivity and reduce costs in the agrarian sector of the economy. The findings of the study confirmed that human capital plays a key role in the implementation of innovations and development of the agrarian sector. Of particular significance is investment in training through modern educational programmes and workshops that enable farmers to master the latest technologies and effective business strategies. The analysis revealed prospects for improvement through the strategic use of existing digital platforms and training courses to enhance human capital capacity. Attention was paid to platforms in Austria, such as Pramoleum and myAcker, which demonstrated the successful integration of digital technologies in the agrarian sector. Analysis of educational programmes and cooperation between universities, businesses, and government agencies in the Netherlands revealed their valuable role in supporting the sustainable development of the agrarian sector, specifically through projects such as Farm of the Future. The conclusions pointed to the need for further investment in human capital development through educational programmes and research, as well as the integration of the latest digital technologies into the agrarian sector to ensure the sustainable development of the creative economy. Consideration of these factors will improve the economic situation, increase production efficiency, and contribute to the sustainable development of the national economy

Keywords: innovation; educational programmes; sustainability; competitiveness; human capital; development; agrarian sector of the economy

INTRODUCTION

In the modern world, rapid technological development, digitalisation, and globalisation are changing conventional economic models and requiring a rethinking of approaches to the development of national economies. One of the most dynamic and promising areas is the creative economy, which includes innovative and creative industries that generate new sources of economic growth and ensure prominent levels of employment, talent development, and intellectual property. Human capital plays a special role in the development of the creative economy, as its knowledge, skills, creativity, and ability to innovate are the primary factors that determine success in the creative industries. Therefore, the development of human capital is becoming an essential condition for stimulating innovation and maintaining the competitiveness of economies in the globalised world.

Digital tools play a prominent role in the development of human capital through vocational training in Ukraine. T. Neboha *et al.* (2024) explored the significance of integrating the latest technologies to upskill workers, focusing on the need to constantly update skills in response to changes in the economy. The findings of this study showed that digitalisation is a key factor for increasing the efficiency of human capital. However, the lack of a unified digital training strategy remains a challenge. An issue that needs further study is how to optimise the use of digital tools to keep skills up-to-date in the context of economic change, especially during Ukraine's post-war recovery. The decline in the effectiveness of human capital development in the context of economic change is a pressing issue. F.B. Mecocci *et al.* (2022) studied the impact of cultural production on human capital in

European regions, showing a positive relationship between employment in cultural sectors and human capital development. However, there is a need for a deeper study of the local characteristics and classification of human capital in the context of different types of cultural activities.

Investments in human capital are key to the development of the creative economy. S. Londar *et al.* (2020) explored the effects of investment in education and science on the development of the creative economy in Eastern and Central Europe. The findings showed that increased funding in these areas contributed to increased competitiveness and socio-economic development. However, the lack of funding in Ukraine requires further research on the effectiveness of such investments for the creative industries. Human capital development is key to the growth of the creative economy. N. Kuznetsova *et al.* (2022) examined the role of human capital in this process, focusing on the significance of investments in education and health for the development of creative industries. The findings confirmed that investments in human capital contribute to innovation and the development of the creative economy. However, the effectiveness of such investments in distinct cultural contexts requires further investigation.

The value of human capital for the development of the cultural and creative economy requires further study. Y. Horban *et al.* (2021) explored the role of intellectual and creative capital in economic development, emphasising the significance of education and creative abilities for creative industries. The findings showed that these factors contributed to economic growth and value creation. However, there are still issues that require further study, including the effectiveness of such investments in various countries. Intellectualisation and the role of human capital in the development of the creative economy are prominent aspects that require further investigation. I. Kalenuk & N. Kuznetsova (2020) explored the effects of people's creative abilities, skills, and talents on the economy, emphasising the value of creative industries for the growth of national economies. The researchers defined the creative economy as a sector that unites industries based on creative activity and as a system of socio-economic relations associated with the development of creative human capital.

Still, more research is needed on how new educational methods fit into creative industries and how they affect the development of human capital in the context of digitalisation.

The growing role of creative corporations in economic development requires an in-depth study of human capital. T.V. Posnova (2021) analysed the effects of creative human capital on the functioning of creative corporations, emphasising its value for innovation and the production of creative products. The researcher noted that creative corporations, unlike other types of enterprises, are based on the creative abilities of their employees, which allows them to generate innovations and create competitive advantages. However, the identified gaps, specifically, the lack of a sufficient number of trained management personnel for creative corporations in Ukraine, require further investigation.

Increase in the role of creative human capital in economic development also warrants more detailed research. S. Duca (2023) investigated the significance of creative human capital as a resource for knowledge management in the economy, highlighting its impact on innovative development and economic growth. The researcher noted that insufficient management of creative potential can hinder the development of a country, while the effective use of creative resources stimulates innovation. The findings of the study revealed that investments in education, research, and innovation systems contribute to the development of creative capital and improve the economic situation. However, there is a need to further explore the effects of government policies on the integration of international programmes to support the creative industries to ensure sustainable development.

The purpose of the present study was to investigate the role of human capital in stimulating innovation and developing the creative economy, specifically through educational initiatives and technological investments. The objectives of the study were to assess the role of human capital in the development of creative industries and its impact on the innovation process; to identify key factors that contributed to the establishment and development of human capital in the creative economy, particularly through education and support for innovation.

MATERIALS AND METHODS

The study was theoretical-analytical and applied in nature. The study was based on the analysis of academic publications such as I. Slaus & G. Jacobs (2011), Y. Tochylna (2019), S.K. Baidybekova & S.B. Sauranbay (2022), which provided an in-depth understanding of the theoretical foundations of the creative economy, as well as practical approaches to the development of human capital and innovation processes in various sectors of the economy. These publications became the basis for analysing current trends and challenges faced by the agricultural and creative industries in integrating the latest technologies and methodologies. Open-source publications such as AgroPortal (AgroPortal, n.d.), AgroHub (Analyzing millions of numbers..., n.d.), E-Agriculture (E-Agriculture, n.d.) were also employed to analyse modern digital platforms that facilitate the integration of technology into the agrarian sector. These sources helped to assess the effectiveness of platforms for data exchange between farmers, suppliers, and consumers, as well as to identify opportunities for optimising logistics processes and developing new business models in agriculture.

The study examined various programmes and courses that promote the development of the creative economy through non-formal learning. Specifically, online platforms were considered, including Coursera – course “Agribusiness and Sustainable Food Production Economics” (Agribusiness and Sustainable Food..., n.d.), UdeMY – course “Greenhouse Farming Foundation” (Greenhouse farming foundation, 2022), edX – course “WBGx: e-Learning on Digital Agriculture” (WBGx: e-Learning..., n.d.).

The agrarian sector was selected for consideration of the creative economy because of its potential for innovation and new business models. Furthermore, the agrarian sector is key to sustainable development and food security, while creative approaches such as clustering and cross-sectoral cooperation can contribute to economic growth and competitiveness. Digital platforms for monitoring the condition of crops were considered, such as Agriquest (Satellite monitoring..., 2020), Coptical (Free digital platforms..., 2022), xarvio Field manager (Field manager..., 2020). The study also included the

FarmLogs mobile application (FarmLogs, n.d.) and the AgriWebb livestock management software (AgriWebb, n.d.).

The study conducted a SWOT analysis to assess the effects of human capital development on the innovation process in the agrarian sector. The analysis helped to identify the strengths, weaknesses, opportunities, and threats associated with the integration of the latest technologies and the upgrading of employees' skills. This included an assessment of aspects such as the use of precision farming and biotechnology, as well as the effectiveness of digital platforms for managing and monitoring agricultural processes. The SWOT analysis helped to identify key factors to increase productivity, reduce costs, and improve the quality of agricultural products.

Austria was chosen for the analysis because of its successful application of innovative approaches in the agrarian sector, including the integration of creative industries and digital technologies. The country has actively employed cooperation and clustering models to promote agriculture, gastronomy, and technology. Projects such as Pramoleum (Welcome to Pramoleum, n.d.), KochCampus (KochCampus, n.d.), and myAcker (myAcker, n.d.) demonstrated how investments in human capital stimulate economic growth and create new business models.

RESULTS AND DISCUSSION

Role of human capital in the development of the creative economy

Human capital is one of the crucial categories in modern economic theory. This concept encompasses not only the physical and intellectual abilities of individuals, but also their ability to innovate, develop, and adapt to change. Human capital determines labour productivity, the level of innovation, and the competitiveness of national economies and is a prominent factor in economic development at the global level. This is especially evident in the context of the creative economy, where the role of human capital is becoming even more valuable.

According to human capital theory, human capital is the sum of knowledge, skills, experience, and health that enables an individual to perform productive work and generate economic growth. According to this theory, education,

training, experience, social connections, and physical and mental health directly influence productivity and the ability to innovate. Notably, human capital is not only an individual resource, but also a collective one, and its effective use at the level of enterprises, organisations, and entire countries is the basis for economic growth and sustainable development. In classical economic theory, capital is traditionally divided into physical, financial, natural, and human capital. Human capital, unlike other forms of capital, is directly related to the potential of people – their ability to create, work, and generate innovative ideas. Improving the level of human capital involves continuous education and self-improvement, as it allows preserving and increasing knowledge that becomes the basis of the innovation process in various sectors of the economy. Human capital underlies economic growth and development, as no sector of the economy can function without capable and skilled workers. Human capital determines not only the volume of production, but also the quality of products, the effectiveness of management decisions and the ability to adapt to rapid changes (Slaus & Jacobs, 2011).

In the modern world of economic development, human capital has become no less significant than physical capital. This is especially true in the context of the creative economy, where the primary resource for growth and development is not raw materials, but knowledge and innovation. The creative economy, unlike conventional economic models, focuses on creating added value through the generation of innovative ideas, cultural products, and services, as well as through the use of intellectual potential. An essential aspect of this economy is the ability of individuals to generate new ideas, and thus human capital becomes not only the basis for economic stability, but also the primary tool for achieving success in a global competitive environment (Tochylina, 2019).

One significant aspect of human capital is its relationship with innovation. In a creative economy, innovation is central to the economy's competitiveness and ability to adapt to new conditions. Innovation requires a prominent level of knowledge, skills, and creative problem-solving. Accordingly, investments in human capital

development directly influence the country's innovation potential. This applies to both businesses and governments, which should create the conditions for human capital development through education systems, research, and training programmes (Chaikovska, 2023).

The role of human capital in economic development is most clearly manifested in those countries where the primary sources of growth are intellectual resources rather than natural or physical resources. Examples of such countries are Japan, South Korea, and some European countries, where investments in education and human capital development have led to extensive economic growth. In these countries, human capital not only increased the efficiency of economic processes but also became the basis for the creation of innovative products and services, which enabled the countries to take a leading position in the international economy (Baidybekova & Sauranbay, 2022). On the other hand, the absence or insufficient development of human capital can lead to economic decline. For instance, countries where the level of education and skills of the labour force is low often experience economic stagnation, lower levels of innovation and productivity, as observed in some African countries such as Nigeria, Somalia, and Chad. In such circumstances, economies can become dependent on raw materials or cheap labour, which does not allow for sustainable development in the long term.

Understanding the relationship between human capital and the creative economy is a major aspect for developing effective economic development strategies at the global and national levels. Therefore, to achieve economic growth, it is essential not only to invest in human capital development, but also to integrate it with creative industries to ensure sustainable economic development. Considering that the creative economy is based on innovative ideas, technologies, creative problem-solving approaches and innovative products, human capital is the primary resource that enables these innovations. Educated, skilled, and creative people are the principal driver of development in creative industries such as design, culture, art, media, advertising, and technology companies. A study by the United Nations Development Programme

in March 2024 reported that Ukraine's Human Development Index (HDI) is 0.734, which means that the country is in the category of high human development. Among 193 countries and territories, Ukraine ranked 100th (Protsenko, 2024).

The creative economy, in turn, contributes to the development of human capital by stimulating innovation and creating new opportunities for learning and self-improvement. One of the key aspects of the creative economy is the opportunity for people to use their creativity and intellectual potential to create new products and services. This creates a demand for new skills and knowledge, which stimulates the development of the education and training system. Creative industries enable the development of entrepreneurial skills, as these industries are often based on individual or small businesses that require creative and entrepreneurial approaches to doing business (Hmyria, 2023). This allows people to develop not only technical but also managerial skills, which are essential for creating and sustaining innovative companies. Furthermore, the creative economy makes extensive use of digital technologies, which provides an opportunity to develop digital skills among employees and enables the creation of new tools for learning and development.

The interaction between human capital and the creative industries is manifested through a variety of factors that ensure productivity and innovation in this area. One of these factors is the close relationship between education and innovation. Human capital, specifically its educational aspect, is the basis for creating innovations in the creative industries. Creativity requires not only inspiration, but also prominent levels of education, learning ability, and constant updating of knowledge. This contributes to the creation of new products, services, and technologies that form the creative economy. Additionally, human capital ensures the efficiency of work processes in the creative industries. Teamwork, communication skills, managerial competence, and analytical skills are essential for the successful implementation of creative projects. The greater the level of human capital in this context, the more efficiently innovative ideas are implemented, which contributes to economic development at all levels – from

individual enterprises to entire national economies (Horban *et al.* 2021).

Furthermore, not only formal education, but also non-formal learning, various courses, trainings, and workshops that allow people to develop their creative skills, play a vital role in the development of the creative economy. For example, online platforms such as Coursera offer creative skills courses for the agrarian sector, such as Agribusiness and Sustainable Food Production Economics (Agribusiness and Sustainable Food..., n.d.), which helps participants improve their ability to solve environmental and production problems in agriculture. Udemy also offers trainings, such as the Greenhouse Farming Foundation (Greenhouse Farming Foundation, 2022), which allow developing farm management skills essential for innovation in agricultural industries. For those who want to learn more about digitalisation in the agrarian sector, the edX platform offers the WBGx: e-Learning on Digital Agriculture course (WBGx: e-Learning..., n.d.), which addresses the use of digital technologies to improve agricultural productivity. These courses can be useful for developing innovative approaches and creative solutions in the agrarian sector.

Human capital plays a key role in the development of the agrarian sector, as the level of employees' skills and knowledge determines the success of innovations, modernisation of production and adaptation to changes in agriculture. In the modern agrarian sector, human capital not only supports conventional farming methods but also contributes to the active development of innovative technologies and production efficiency through digitalisation and innovative approaches.

The modernisation of the agrarian sector requires employees to be highly skilled in areas such as precision farming, hydroponics, agro-technology, robotic systems, data management, and big data analysis. Improving the level of education among farmers is also crucial, as knowledge of the latest technologies allows them to effectively apply modern methods of tillage, irrigation, and resource management. The growing role of human capital in the adoption of innovative technologies is creating a demand for specialists with digital skills who can

use drones to monitor fields, satellite images to predict yields, or even develop software to automate agricultural processes.

Digitalisation in the agrarian sector can reduce costs, optimise processes, and increase productivity, but it requires highly skilled workers who can work with new platforms and digital tools. For instance, precision farming platforms such as xarvio Field manager (Field manager..., 2020) allow farmers to manage their fields based on data collected via satellites, drones, and sensors. People who can use these technologies must have specialised skills in working with such platforms, as well as knowledge of agronomy to apply the data correctly.

Innovations and digital technologies are also linked to the development of the creative economy in the agrarian sector. Creative approaches to growing crops, vertical farms, hydroponics, and other innovative farming methods help to reduce the effects of external factors such as climate change and optimise the use of resources. In this context, human capital is the basis for the development of new business models that not only increase profitability but also ensure the sustainable development of the agrarian sector while maintaining environmental balance.

The prospects for human capital development in the context of the creative economy are closely linked to the development of innovations, technologies, and educational initiatives. To succeed in this area, it is necessary to integrate curricula and educational processes with the real needs of the creative economy, actively attract talent, and create conditions for their development and implementation. The creative economy requires employees to have not only technical and specialised knowledge, but also the ability to adapt, creativity, and the ability to work in an unstable environment. Considering the rapid changes in the technological environment, human capital should be focused on continuous development and improvement, which allows it to adapt to new economic realities and support the innovation process.

The present study and the study by A.M. Ausat *et al.* (2023) emphasised the significance of human capital as a key factor in economic development, particularly in the context of modern challenges and transformations. The

researchers emphasised that human capital development was necessary to ensure innovative development, increased productivity, and overall economic growth. Both studies focused on the significance of human capital for economic development, but the present study was more focused on the specifics of the Ukrainian economy and its adaptation to modern requirements, while A.M. Ausat *et al.* provided a general view of the role of human capital in the global context, considering different types of capital (intellectual, cultural, social). The present study and the study by S. Malisiova & S. Kostopoulou (2024) also shared a focus on the role of social capital and networks in the development of cultural and creative industries (CCI), particularly in peripheral areas. Both studies highlighted the value of social and cultural resources in supporting innovation and economic development in such regions. Key shared features were in that both approaches emphasised the significance of social networks and their effects on the development of CCIs. The distinction, however, was that S. Malisiova & S. Kostopoulou focused more on cross-sectoral networks and informal ties in local communities, while A.M. Ausat *et al.* (2023) focused on intellectual, social, and cultural capital as the foundations for the development of the creative economy.

The present study and the study by M.F. Carillo (2024) had shared aspects, specifically, the researchers emphasised the significance of human capital for economic development. Both studies recognised that investments in education, training, and technology contributed to increased labour efficiency and innovation. The present study focused on the development of human capital through digitalisation and the latest technologies in Ukraine, particularly in the agrarian sector and creative industries. On the other hand, M.F. Carillo addressed the influence of human capital on long-term economic growth through innovation and technological change in a global context.

The paper by H.S.H. Wijoyo *et al.* (2024) and the present study both focused on human capital development for economic development, but the approaches were distinct. The present study focused on the development of human capital in the agrarian sector and its effects on the creative

economy in Ukraine through innovation, education, and technology. It emphasised the significance of investing in human capital to increase the competitiveness of agricultural enterprises. H.S.H. Wijoyo *et al.* focused more on social capital and networks, as well as the role of governments and access to finance for the development of creative industries, particularly in peripheral regions. The difference was that the present study addressed technological innovation in Ukraine, while H.S.H. Wijoyo *et al.* were more focused on social and cultural aspects at the global level. Both studies recognised the value of human capital, but with different emphasis.

Human capital is an indispensable element of economic development, as its potential determines labour productivity, the level of innovation, and the ability to adapt to change. Investments in education, science, training, and the development of intellectual and cultural capabilities of human capital are essential for increasing competitiveness and economic growth, especially in the context of the creative economy.

Mechanisms of human capital development in the creative economy

Mechanisms for the development of human capital in the creative economy are a major part of the success of modern economies, as human capital provides innovation potential and increases production efficiency in the face of dynamic change. Human capital includes knowledge, skills, adaptability and innovation, as well as motivation and creativity. In the creative economy, where innovation, culture, and creativity are the key drivers, human capital is an essential resource that ensures economic growth through the creation of new ideas, products, and services.

Education is a key factor in the development of human capital. Education systems play a key role in shaping the basis for the development of knowledge, skills, and intellectual potential. In the context of the creative economy, education should be focused not only on the transfer of theoretical knowledge, but also on the development of practical skills that allow people to successfully adapt to changing conditions and continuously improve. It is essential to create educational platforms that foster creativity, critical thinking,

and innovative approaches to problem solving. These skills are crucial for working in the creative industries, where the ability to generate fresh ideas and solve non-standard problems is essential (Vorzhakova & Revtiuk, 2021).

Investment in research and development (R&D) is another prominent factor in the development of human capital. R&D enables the creation of the latest technologies and innovative products, which promotes growth in the creative industries. Investments in R&D activities ensure the development of highly qualified personnel capable of implementing complex innovative projects. Furthermore, R&D contributes to the creation of new knowledge that can be used to develop innovative technologies, products, or services, thereby supporting the development of the creative economy (OECD, 2021).

Alongside technology and innovation, cultural and social institutions that shape values and behavioural norms play an essential role in the development of human capital. Culture and social institutions, such as family, community, and media, influence the development of individuals' creativity, motivation, and ability to fulfil themselves. In the creative economy, cultural institutions not only preserve traditions but also promote the development of new forms of creativity that meet modern market requirements. Cultural values transmitted through social institutions have a pronounced effect on the development of creative ideas and products in various sectors of the economy. Motivation is another valuable factor contributing to the development of human capital in the creative economy. A strong level of motivation is essential for achieving high performance, especially in innovative fields where constant adaptation to change and the search for new ideas are required. Motivation provides individuals with the energy to achieve their goals, fosters creativity, and maintains a solid level of productivity. In the creative economy, where the primary resource is not physical labour but intellectual and creative activity, motivation is the driving force that allows achieving best results and implementing innovative projects (OECD, 2021).

Social networks and communications also play a major role in the development of human capital. Interaction between people, the

exchange of ideas and experiences is a valuable aspect of developing creativity and innovation. Communities that support ideas and innovation provide opportunities for the development of human capital through mutual support and knowledge sharing. Social networks also

provide opportunities for finding new opportunities for self-fulfilment and development, which is essential for the development of the creative economy. Table 1 presents the key factors contributing to the development of human capital in the creative economy.

Table 1. Examples of initiatives and methods that promote human capital development in the creative economy

Human capital development factor	Concrete initiatives and methods
Education systems	Implementation of study programmes in agribusiness, precision agriculture, and biotechnology in higher education institutions. For example, the National University of Life and Environmental Sciences of Ukraine is the innovative higher education institution in Ukraine that implements a dual form of education, cooperating with research institutions and enterprises of agrarian sector.
Research and development activities (R&D)	Joint research between universities and businesses to create new products. Kernel's Open AgriTech University offers 3-5 year students and graduates the opportunity to study in the agri-tech business. The programme includes hands-on training at the company's assets, paid internships, online meetings with experts, and scholarships for the best students.
Technology and innovation	Use of online education platforms and digital technologies to develop new ideas. For example, the Agronomy e-Learning Academy (Purdue University) offers courses such as Agronomy Essentials, Precision Agriculture and Nutrient Management. It provides knowledge on agronomy, precision agriculture, and nutrient management, helping professionals adapt to modern challenges in agriculture.
Cultural and social institutions	Support of cultural initiatives for the development of agricultural regions, such as AGRO-2025, the largest agro-industrial exhibition in Ukraine, which promotes the development of local agricultural producers and culture.
Motivation and entrepreneurship	Start-up support programmes and incubators for young entrepreneurs. For example, AgTech Farm is the largest specialised fund in Ukraine that has invested over \$1 million in agri-tech projects.

Source: compiled by the authors of this study based on data from Open agritech university (n.d.), What's happening to agri- and foodtech startups..., (2023)

The Table 1 provided examples of concrete initiatives and methods contributing to the development of human capital in the creative economy. Each factor, be it education, R&D, technology, cultural institutions or entrepreneurship, has its specifics and implementation methods. These initiatives and programmes not only support the development of human capital but also contribute to the development of the creative economy as a whole, ensuring innovative and sustainable economic advancement.

In the context of modern economic transformations, the agrarian sector is one of the key industries affected by innovative technologies. The introduction of innovative technologies in the agrarian sector not only improves the efficiency of production processes but also contributes to maintaining environmental balance and ensuring food security. However, the development of human capital plays a vital role in the

successful implementation of innovations, as the knowledge, qualifications, and skills of employees are the basis for the effective implementation of the latest technologies in production.

Human capital includes not only the physical workforce, but also the intellectual potential required to adapt to a rapidly changing technological environment. In the agrarian sector sector, this means the need for continuous training and professional development of employees, as well as the ability to adopt the latest farming methods. The development of human capital in the agrarian sector is linked to the formation of key competencies, such as mastery of the latest technologies, creative thinking, the ability to work with big data and other skills that can increase the productivity and sustainability of agricultural production. The primary areas of innovation and the latest technologies in the agrarian sector cover several crucial

areas, including automation and mechanisation of agricultural production, precision farming to improve resource efficiency, development of biotechnology to improve crop varieties and pest control, and digitalisation of agricultural management processes to optimise costs and increase transparency. Precision farming is also one of these areas, using advanced technologies such as the Global Positioning System (GPS), soil moisture sensors, drones, and satellite imagery. These tools allow significantly optimising the use of resources such as water, fertilisers, and pesticides, which not only reduces costs but also increases yields. The use of precision agriculture contributes to a more rational use of land resources and improved soil conditions, which is a major factor for the sustainable development of the agrarian sector (Ranjan *et al.*, 2024).

Another prominent area is innovations in agronomy, specifically biotechnology, which enables the creation of new crop varieties that are resistant to various diseases and climate change. This ensures the stability and sustainable development of agricultural production, as new varieties are more productive and less vulnerable to adverse environmental impacts. The use of biotechnology can improve production efficiency and reduce dependence on chemical pest and disease control agents, which positively influences the environment. Automation of production is another major area that can markedly reduce labour costs and improve the accuracy of agrotechnical measures. The use of robotic technologies for harvesting, irrigation, and soil cultivation enables farmers to reduce labour costs extensively and ensure more efficient processes. Robotic technologies are revolutionising the agricultural industry by increasing efficiency and productivity in harvesting, irrigation, and tillage. Autonomous harvesters and tractors are used for harvesting crops, which can be operated without human intervention. Robots are also used for selective fruit picking, equipped with computer vision to distinguish between ripe and unripe fruit. Drones with multispectral sensors are used to assess the condition of crops and determine the best time for harvesting. Furthermore, robotic manipulators are used for delicate fruit harvesting and processing (Hands-free crop harvested by robots..., 2017). In the field

of irrigation, smart irrigation robots use a network of soil moisture sensors and meteorological data to make real-time irrigation decisions. Autonomous irrigation systems adapt irrigation strategies to particular crop types and growth stages. Precision water application robots prevent waterlogging of the soil, while remote irrigation monitoring systems allow controlling the process through mobile applications (Ghodke *et al.*, 2023). In soil cultivation, lightweight autonomous tractors for spraying, sowing, and rolling minimise soil compaction, which ensures sustainable plant development. Robots are also available to selectively apply pesticides to plants that need them, and drones and ground scouting robots are used to collect data on soil and crop conditions. Robotic systems for precision fertilisation are used based on an analysis of the needs of concrete areas of the field (Robotics applications in agriculture, 2022). These technologies help optimise resource use, increase yields, and reduce environmental impact. They also help solve the problem of labour shortages in the agrarian sector (Zaika *et al.*, 2023). Automation helps to increase the speed and accuracy of work, reducing the probability of errors and increasing overall production efficiency.

Digitalisation is giving rise to new specialisations. For instance, professions such as precision farming specialist or agricultural data analyst are becoming more in demand. Such specialists need to be able to analyse large amounts of data obtained from sensors, drones and satellites and use this data to optimise agricultural processes. Another new profession, the agrobot operator, is emerging in connection with the automation of harvesting and soil cultivation. Robots and autonomous field processing systems are becoming a prominent part of the agricultural infrastructure, and therefore specialists who maintain these systems are in high demand as well. Digitalisation is changing not only skills requirements but also cultural and organisational aspects of the agrarian sector. For example, farmers need to become more open to the adoption of innovative technologies as they require new ways of farming and managing resources. Furthermore, farmers need to be capable of learning and adapting quickly as digital technologies are constantly improving and changing.

Digitalisation is also becoming a significant area of development in the agrarian sector, as the introduction of digital platforms for monitoring crops offers accurate control over the condition of plants, which facilitates prompt response to changes in environmental conditions. One of these platforms is Agriquest (Satellite monitoring..., 2020), a free weather data analysis platform that allows farmers to receive up-to-date information on weather conditions and their impact on yields. Another prominent platform is Coptical (Free digital platforms..., 2022), which uses satellite monitoring to analyse field conditions and provide farmers with data for decision-making. Coptical already covers over 500,000 hectares in Ukraine. For precision agriculture, xarvio Field manager (Field manager..., 2020), a global digital platform that helps farmers manage their fields from sowing to harvesting, is widely used and supports more than 39,000 farmers in 17 countries. Another notable platform is FarmLogs (FarmLogs, n.d.), a mobile application that allows farmers to keep records of all aspects of their operations, such as planting, watering, and harvesting, which greatly simplifies farm management and increases decision-making. For livestock management, AgriWebb (AgriWebb, n.d.) is used, a platform that allows farmers to keep track of livestock, plan feeding, and monitor animal health in real time. These platforms allow farmers to manage their farms more efficiently, reduce costs, and increase productivity by using modern digital technologies.

Several agri-startups are being successfully implemented in Ukraine, actively attracting human capital through the introduction of innovative technologies such as agrodrones, vertical farms, and hydroponics. These start-ups not only contribute to the development of the agrarian sector but also change the structure of jobs by creating new professions that require particular skills and qualifications. Human capital underlies successful operation of such start-ups, as it is the knowledge and experience of specialists that allows them to develop and implement innovative technologies that greatly increase the efficiency of agricultural production.

One successful example is the startup DroneUa (Ukraine became the world..., 2022),

which specialises in using drones to monitor crops, cultivate fields, and collect data on plant health. This startup involved agronomy, engineering, and IT specialists who developed software to analyse the data. As a result, farmers can reduce the cost of cultivating their fields by up to 30% and increase yields by 15-20%. In this case, human capital in the form of highly qualified specialists became the basis for the startup's development, as the effective implementation of such technologies requires knowledge of both agronomy and information technology.

Another example is Vertical Farm Ukraine (Ukrainian innovative vertical farm..., 2022), a project that implements the concept of vertical farming in urban environments using hydroponics and aeroponics. This startup actively engages agronomists and engineers to develop and implement innovative plant growing technologies. Human capital, including agronomy and engineering specialists, has helped to create effective business models for growing fresh vegetables and herbs throughout the year. This reduces transportation and storage costs, which is essential to ensure a steady supply of produce to urban areas.

These cases demonstrate how agri-startups in Ukraine are using the latest technologies to improve agricultural efficiency while investing in human capital through training and development of employees. Human capital plays a crucial role in creating successful agri-start-ups, as it is the knowledge, skills, and experience of professionals that form the basis for the implementation of innovative technologies. Skilled personnel provide the necessary knowledge to develop and implement innovative technologies such as agrodrones, vertical farms, and hydroponics. Furthermore, innovative thinking, which is developed through training and practical experience, allows generating fresh ideas and solutions that greatly improve production efficiency.

Thus, the success of agri-start-ups in Ukraine directly depends on human capital, which underlies the development of technologies and the creation of new business models in the agrarian sector. Education, specialised courses, and practical experience help to improve the skills of employees, which in turn increases the efficiency of agribusiness, helps to

adapt to market changes and ensures the sustainable development of the agricultural industry. Automation of accounting and management systems at enterprises can markedly reduce the cost of management functions and increase the efficiency of agricultural enterprises. This includes the use of software to manage yields,

plan crops, control resource turnover and forecast economic outcomes, which allows for optimisation of production processes and increase the overall efficiency of enterprises. Table 2 presents a SWOT analysis that reflects the key factors that influence human capital development and innovation in agriculture.

Table 2. SWOT-analysis of the introduction of innovations and innovative technologies in the agrarian sector of the economy

Strengths	Weaknesses
<ol style="list-style-type: none"> 1. Increased potential for productivity improvement through the latest technologies (precision farming, automation). 2. Optimisation of the use of resources, such as water, fertilisers, and pesticides, through the application of the latest technologies that reduce costs and increase production efficiency. 3. Improvement of environmental sustainability and conservation of natural resources through the introduction of technologies that reduce the use of chemicals and minimise adverse environmental impact. 4. Increased competitiveness of agricultural enterprises in the international market through optimisation of production processes and export of innovative products. 	<ol style="list-style-type: none"> 1. Insufficient dissemination of information about the latest technologies among some farmers. 2. Excessive initial costs of implementing innovations. 3. Lack of adequate training of personnel to work with the latest technologies. 4. Technical and organisational challenges in integrating innovative technologies into conventional production processes.
Features	Threats
<ol style="list-style-type: none"> 1. Growing demand for environmentally friendly products, which drives innovation. 2. Development of international partnerships and cooperation in the agrarian sector of the economy, which facilitates the transfer of technology and knowledge. 3. Improved access to finance for investment in innovative technologies through public and private support programmes. 4. Increased access to advanced digital platforms and tools for data analysis and monitoring of production processes in the agrarian sector of the economy, which enables improved efficiency and cost reduction, including through external initiatives and international partnerships. 	<ol style="list-style-type: none"> 1. Risk of losing conventional jobs to automation and robotics. 2. Dependence on external technology and parts suppliers. 3. Potential market volatility and uncertainty over investment returns. 4. Elevated level of risk if technology is not applied correctly (poor integration or underestimation of impact).

Source: compiled by the authors of this study based on data from S. Zaika *et al.* (2023), A. Ranjan *et al.* (2024)

Overall, the introduction of innovations and the latest technologies into the agrarian sector through human capital development is a key element for ensuring the sustainable development of the sector. The SWOT analysis revealed that while there are significant opportunities for increasing the productivity and environmental sustainability of agricultural production, proper education and training is a crucial precondition for the successful fulfilment of these opportunities. It is necessary to ensure that workers develop the adequate skills to implement the latest technologies and innovations effectively, which will minimise risks and maximise the potential for growth in the agrarian sector.

Education and digital technologies substantially affect farm productivity and income,

as evidenced by studies from various regions. The effects of education on farm productivity are evident. M. Reimers & S. Klasen (2011) found that each additional year of farmer education increases agricultural productivity by 2-5% in high-income countries. The greatest effect was observed for primary and secondary education, while tertiary education had no significant effect on productivity. This demonstrated the value of basic knowledge for farmers who can effectively innovate and adopt modern farming practices. Additionally, a study in the Offinso Municipality of Ghana found that farmers with secondary education had 15-20% greater yields than those with only primary education. Furthermore, access to extended services such as extension can increase productivity by 25%, although the coverage of such services continues

to be low. This underscores the significance of education not only in formal training, but also in access to practical knowledge and advice that can greatly improve farm efficiency.

Digital technologies also markedly affect farmers' incomes. A 2014 study of 676 farmers in Guangdong province, China, found that the use of digital technologies such as the Internet of Things (IoT) and data analytics increased incomes from agricultural production and sales by 12-18%, especially for highly skilled farmers. Digital technologies also reduced the negative impact of distance to market by 30%, allowing farmers to get their products to end users faster and cheaper (Oduro-Ofori *et al.* 2014). Platforms such as Farm Pass (India, Africa) enabled farmers to increase their income by 20-35% through direct access to buyers, digital payments, and the ability to obtain loans based on financial history. For example, farmers in India receive payment on the day of sale, which reduces losses from delays and improves the financial stability of farms (True prosperity will be found..., 2023).

In Ukraine, education and the adoption of digital technologies greatly influence farm productivity and income. 66% of farmers in Ukraine have a university degree, which positively affects their productivity. Farmers with higher education demonstrate 20-30% higher productivity compared to those with only secondary or vocational education. The study also showed that farmers who take advanced training courses can increase their productivity by 15-25% through the introduction of innovative technologies and farming methods. In Ukraine, there are online education platforms such as AgroPortal and AgroHub that help farmers acquire new knowledge and skills that can improve their efficiency (Varchenko, 2019).

Overall, the key findings were that education is most effective in a context of rapid technological advancement, when farmers can adapt innovations more quickly and increase their productivity. Digital technologies not only increase incomes, but also simplify access to financial services, reducing dependence on conventional intermediaries. Expanding educational programmes and digital infrastructure in rural areas is key to the sustainable development of the agrarian sector, as it creates favourable

conditions for innovation and improves the economic efficiency of farms.

The present study and the study by M.Y. Darsyah *et al.* (2024) shared a focus on the development of human capital for the creative economy, but their approaches differed. Both studies stressed the significance of investing in education, training, and the latest technologies for the development of creative industries. At the same time, the present study focused on particular industries, such as the agrarian sector of the economy in Ukraine, and the value of integrating digital technologies and precision farming to increase productivity. M.Y. Darsyah *et al.*, on the other hand, focused on general approaches to developing the creative economy through infrastructure, digital platforms, and education, without focusing on concrete sectors.

The present study focused on the development of human capital in the agrarian sector, emphasising the role of education, innovation, and technology in increasing the productivity and competitiveness of agricultural enterprises through the introduction of the latest technologies such as precision agriculture and digital platforms. J.D. Snowball & R. Haines (2024) focused more on the global aspects of supporting creative industries, while the present study focused on particular innovations and technologies in the agrarian sector. The findings of D. Divianto *et al.* (2024) and of the present study had a shared focus on the value of human capital for the development of the creative economy. Both studies emphasised the significance of investments in human capital and government support for the development of creative industries. Furthermore, they highlighted the role of social capital and infrastructure as factors influencing the development of this sector. However, D. Divianto *et al.* paid more attention to intellectual capital, specifically human capital and its influence on the financial success of SMEs in the creative economy, using quantitative methods.

The paper by B. Fotuhi Mehrabani *et al.* (2022) and the present study had a shared theme in terms of the significance of human capital for economic development, specifically, for the creative economy. Both studies emphasised the role of investment in human capital to stimulate innovation and economic growth and recognised

the significance of government initiatives. The present study focused on the adoption of technology in the agrarian sector, namely precision agriculture and digital platforms, while the B. Fotuhi Mehrabani *et al.* investigated the spatial distribution of creative capital in Iranian metropolises and its impact on economic growth.

Human capital is a critical factor in economic development in the creative economy. Its value lies not only in knowledge and skills, but also in the ability to innovate, adapt, and solve problems creatively. In a creative economy, human capital ensures the creation of innovative ideas, products, and services, which forms the basis for economic growth.

Use of human capital potential to develop the creative economy in the agrarian sector

The agrarian sector of the economy is one of the oldest and crucial areas of economic activity, but it has undergone major transformations over time due to the introduction of innovations and creative approaches. Creative approaches in the agrarian sector include a variety of strategies to help adapt to global challenges, such as climate change, growing demand for environmentally friendly products, the need to increase resource efficiency, and sustainable development. These approaches help farmers to optimise their processes, reduce costs, improve product quality, and ensure sustainable development at the local level.

Creative approaches to cooperation and clustering have been the basis for many agricultural initiatives. In some countries, farmers unite to form cooperatives or clusters, enabling them to exchange knowledge, improve efficiency, and reduce costs. In Austria, Pramoleum has created a unique model of cooperation by bringing together farms to grow pumpkins and produce pumpkin seed oil (Rural and high-tech..., 2021). This cooperation not only reduced production costs but also expanded the range of products and created new jobs for local residents. Furthermore, this approach has contributed to the development of the regional economy by creating new business models and increasing demand for pumpkin seed oil on the local market. Another example is the KochCampus Association,

which brings together chefs, restaurateurs, and farmers to jointly develop new products and test new crops in the catering industry (Rural and high-tech..., 2021). This approach not only supports local producers, but also promotes gastronomic tourism, which is a major part of the economy in many Austrian regions. The project also serves as an excellent example of how the agrarian sector can be integrated with other economic sectors to create added value. The introduction of digital technologies in the agrarian sector can reduce costs, increase the efficiency of production processes, and ensure sustainable development. One example is the Austrian myAcker project, which allows consumers to rent beds online and monitor the cultivation of vegetables via smartphone or tablet (Rural and high-tech..., 2021). This allows for a new model of interaction between the consumer and the producer, where everyone can become part of the agricultural process, observe the growth of their products, and even take part in choosing what to grow. This approach helps to engage people in agricultural production, raise awareness of agriculture and encourage sustainable consumption.

The use of human capital for the development of the creative economy in the agrarian sector is one of the key factors contributing to the modernisation of agriculture, increasing its efficiency and environmental sustainability. The Netherlands is a prime example of how human capital can drive innovation and create new opportunities for the agrarian sector, specifically through the introduction of advanced technologies, the development of digital initiatives and the implementation of sustainable agricultural practices. A highly educated workforce, research, and effective collaboration between universities, businesses, and farmers are leading to prominent results in agriculture.

The role of human capital in the creative agrarian economy in the Netherlands is invaluable. Highly skilled people, such as specialists in agronomy, engineering, and the IT sector, contribute to the development of innovative technologies such as precision farming, robotics, hydroponics, vertical farms, and sustainable agricultural practices. Collaboration between

academic institutions, government, and the private sector in the Netherlands actively promotes innovation. For instance, partnerships between universities and agricultural enterprises have led to breakthroughs in the development of new crops, improved water management systems, and the introduction of innovative technologies in greenhouse farming. Such innovations can reduce water costs, preserve biodiversity and markedly increase yields (OECD, 2015).

One of the most prominent examples of innovation in the Netherlands is the Wageningen University Farm of the Future concept, which focuses on sustainable farming systems using zero fossil fuels. Within the framework of this project, eight different crops are being experimented with, which helps to increase biodiversity, soil health, and yield efficiency. Innovative drainage systems are also being introduced to store excess water underground for reuse during dry periods. This can greatly reduce dependence on conventional irrigation methods and improve water use efficiency (OECD, 2015).

Another successful example is innovation in greenhouses, where Dutch farmers use ultra-modern technology such as automated climate control systems and LED lighting to grow vegetables and flowers year-round. This maximises the productivity of the land while minimising energy consumption, which is essential for the sustainable development of the agricultural industry. Thanks to such initiatives, farmers can ensure sustainable production with minimal environmental impact. Furthermore, the CAP Strategic Plan (2023-2027) in the Netherlands supports farmers in their transition to sustainable agriculture. This is achieved through individualised regional strategies that ensure not only a fair distribution of income, but also food security and environmental sustainability. This strategy allows farmers to adapt to new conditions, use resources efficiently, and reduce their environmental impact (Netherlands – CAP Strategic Plan..., n.d.).

Human capital also contributes to the development of an export-oriented agri-food economy in the Netherlands. The country is the second largest exporter of agricultural goods in the world, with exports worth over EUR 100 billion annually. Creative approaches in logistics, pack-

aging, and innovation contribute significantly to this achievement. The Netherlands has successfully integrated human capital into the development of new packaging, logistics and delivery methods, making its products high quality and competitive on global markets.

Lessons from the Dutch experience show that human capital is a crucial factor for the development of a creative economy in the agrarian sector. Highly skilled personnel, innovative approaches and effective cooperation between research institutions, government and business allow the Netherlands to stay a leader in agriculture. Educational programmes and investments in human capital development ensure the sustainable development of the agrarian sector, addressing environmental issues and creating new business models that contribute to increased productivity and environmental sustainability in agrarian sphere.

Digitalisation of the agrarian sector is an important stage of development in Ukraine. Involving young people in the development of digital technologies is a major step towards increasing the efficiency of production and marketing. Various platforms for data exchange between farmers, suppliers, and consumers are actively developing in Ukraine, such as AgroPortal (AgroPortal, n.d.), AgroHub (Analysing millions of numbers..., n.d.), E-Agriculture (E-Agriculture, n.d.), which allows for better management decisions and reduced costs (Creative approaches, 2021). Each of these platforms has its own impact on the work of enterprises in the agrarian sector, helping to improve communication, management processes, and reduce costs. AgroPortal is one of the leading information exchange platforms in the Ukrainian agrarian sector. It enables farmers to receive up-to-date information on product prices, industry news, and government support programmes. Using AgroPortal helps to improve management decisions, as farmers can quickly respond to changes in the market. Furthermore, the platform helps to reduce costs by providing access to up-to-date data, which allows farmers to plan input purchases and sales more efficiently. AgroHub is another platform that actively supports farmers in Ukraine. It is focused on creating an ecosystem for the

exchange of knowledge and experience among farmers. AgroHub allows farmers to upgrade their skills through online courses and trainings, which improves their farm management skills. The platform also facilitates communication between farmers, suppliers, and consumers, which reduces transport and logistics costs through more accurate and prompt orders. E-Agriculture is a platform that supports farmers in using digital technologies to manage their farms efficiently. It allows farmers to access online resources, tools for monitoring and analysing data, which is essential for making informed management decisions. The use of this platform improves agricultural communication and reduces costs, as the platform provides accurate monitoring of resources and allows for optimisation of the processes of growing, harvesting, and processing agricultural products. Overall, these platforms help farmers improve market access, optimise management processes, and reduce costs, as well as improve farmers' skills and facilitate communication between agricultural market participants. They enable farmers to adapt to market changes more quickly, increase efficiency and reduce financial risks, which is critical in times of economic instability. Climate change and global environmental issues are forcing the agrarian sector to adapt to new conditions. The use of environmental technologies to reduce the adverse impact that agricultural production has on the environment is one of the most significant creative approaches in this area.

One such example in Ukraine is the creation of biogas complexes for processing agricultural waste. These facilities can process organic waste such as manure, haylage, and other biological materials into energy that can be used for farmers' needs. Such complexes also reduce the amount of waste in landfills and contribute to soil conservation, as the residues after processing can be used as organic fertiliser (Rural and high-tech..., 2021).

Another example is the development of climate-smart agriculture in Ukraine. Adapting the agrarian sector to climate change is becoming increasingly significant for food security. This includes the use of drought-tolerant crops, water, and energy conservation methods,

and the application of the latest agricultural technologies to increase productivity in an unstable climate. Climate-smart approaches can markedly reduce crop losses and make agriculture more resilient to extreme weather conditions. Technologies such as precision farming and no-till farming methods reduce CO₂ emissions, increase soil resilience to climate challenges and guarantee sustainable agricultural development. These technologies can reduce tillage costs, reduce the risk of erosion, and improve soil structure. This is an important part of maintaining food security in the face of climate change (Prospects for the development..., 2024).

Proactive approaches that can increase productivity and help adapt to new economic, environmental, and social challenges are a powerful tool for sustainable development of the agrarian sector. Innovations, such as innovative technologies, digitalisation, cooperation, and eco-friendly methods, allow the agrarian sector to become more competitive and ensure sustainable development at all stages of the production cycle. Considering the current trends, the agrarian sector has a massive potential for development if creative and innovative solutions are implemented.

The present study and the study by Y. Ionin & A. Prysich (2024) had a shared focus on the significance of digital technologies for economic development and improving the efficiency of management processes. Both studies emphasised the role of digital tools in optimising business processes and increasing the competitiveness of enterprises. However, the difference between them was that the present study focused on the development of human capital and its relationship with the creative economy, while Y. Ionin & A. Prysich focused more on digital technologies and their influence on management structures.

The study by C. Chaiboonsri (2024) and the present focused on the value of human capital for economic development, but with different emphases. Both studies emphasised the need to invest in education, innovation, and technology. C. Chaiboonsri emphasised the role of cultural industries, which contribute to economic growth through creativity and new jobs. The present study, on the other hand, focused on the

development of human capital in the agrarian sector, specifically through precision agriculture and digital technologies to increase productivity. Both studies recognised the value of investment in R&D, but C. Chaiboonsri focused more on cultural and social capital, while the present study underscored technological innovation in the agrarian sector.

The current study and the study by D. Kalfas *et al.* (2024) converged in their emphasis on the role of cultural and creative industries for economic development and social cohesion. Both studies emphasised their significance for job creation and entrepreneurship. D. Kalfas *et al.* focused on the social and cultural aspects of urban regeneration in Europe. This study and the study by L.J.S. Baiyegunhi (2024) shared a focus on the significance of human capital for economic development. Both studies highlighted the value of investing in education, research, and innovation to increase productivity and stimulate economic growth. The present study focused more on the cultural and creative industries, exploring their role in regional development and recovery through an analysis of sectoral impacts on the economy. At the same time, L.J.S. Baiyegunhi's study focused on the agrarian sector and focused on human capital development through training of farmers to increase their productivity and resilience to change.

The present study and the study by W.-J. Yan & S.-T. Liu (2023) had a shared focus on the development of the creative economy, particularly through innovation and human capital. However, the approaches differed: the present study focused on the development of human capital through education and technological innovation to stimulate the creative economy, while the study by W.-J. Yan & S.-T. Liu focused on cultural aspects and the management of the creative economy through cultural policies. Both approaches recognised the significance of innovation, but from different standpoints – through human capital and cultural governance.

This paper and the study by Y.F. Yoga *et al.* (2023) both addressed the development of the creative economy through investment in human capital and entrepreneurship support, emphasising the significance of public policy and infrastructure. Both studies examined the role

of human capital and innovation in supporting economic growth in the creative industries. However, Y.F. Yoga *et al.* focused on infrastructure initiatives and government programmes in specific regions of Indonesia, while the present study focused more on the agrarian sector and technological innovations, such as digitalisation and precision agriculture, to stimulate the development of the creative economy.

Investments in education and research are essential for the development of human capital in the agrarian sector in the context of the creative economy. Programmes aimed at developing creativity, innovation, and entrepreneurial skills should be available at all levels of education, including at agricultural universities and specialised training institutions for agricultural professionals. For example, courses in agribusiness, precision farming, agronomy, ecology, and sustainability can prepare students for the challenges of the modern agricultural market. This will enable young professionals not only to work effectively with the latest technologies, but also to run a successful business in the agrarian sector.

Furthermore, it is vital to stimulate research and development activities in the field of agricultural technology and innovation. An example is investment in biotechnology research, particularly in genetic modification of crops, which enables the development of varieties that are more resistant to climate change. It is also worth paying attention to the development of agri-platforms for monitoring soil health, which allows farmers to obtain accurate information to increase productivity and reduce costs.

The creation of effective educational platforms for the development of specialised skills is a prominent aspect for the agrarian sector. Such platforms can include courses and trainings on the use of precision agriculture, automation of agricultural processes, and the development of sustainable production methods. For instance, platforms that teach farmers how to use drones to monitor crops or soil data collection systems can help young farmers to implement innovative technologies in their operations, markedly reducing costs and increasing efficiency. Supporting cultural and social initiatives in the agrarian sector should be a priority in human capital development policy. It is vital to stimulate

the development of cultural and social projects in agricultural regions, such as the organisation of agritourism festivals, agricultural exhibitions or the creation of rural cultural centres. Such initiatives foster creativity in communities and can become a new source of employment, which will also improve social stability in the regions.

Engaging young people in creative agricultural industries is essential for innovation and sustainable economic growth. Programmes that foster the development of young talent in areas such as digital agriculture, food processing or agribusiness can help to create a new generation of entrepreneurs and innovators. For example, programmes to support agri-innovation start-ups can help young farmers create competitive products and services that meet global market demands. To ensure the sustainable development of the agrarian sector, it is necessary to introduce innovative technologies such as precision farming, automation of agricultural production processes, biotechnology and renewable energy sources. For example, farmers who use monitoring systems to determine water and fertiliser requirements can significantly reduce input costs and increase yields. It is also worth addressing the development of biofuels and renewable energy-oriented agricultural enterprises, which helps to reduce the environmental impact of agriculture.

Integration of international practices is a valuable condition for the development of human capital in the agrarian sector. Involvement in international support, training and cooperation programmes will allow Ukrainian farmers to gain access to advanced technologies and best practices. For example, participation in international projects on precision agriculture or organic production will allow adapting these technologies to Ukrainian conditions, increasing competitiveness in the global market and ensuring sustainable development of the agrarian sector.

CONCLUSIONS

The development of human capital is the basis for increasing the competitiveness of national economies, specifically in the context of globalisation, rapid technological change, and the challenges posed by climate change and

economic instability. A creative economy based on intellectual and creative resources requires the development of human capital capable of generating innovative ideas, products, and services. This allows not only to increase production efficiency, but also to adapt to new market requirements, increase innovation and ensure sustainable development. Investments in human capital, including in education, research and development, and the latest technologies, are essential to foster the development of the creative economy, particularly in industries such as information technology, media, design, culture, and the arts.

The study demonstrated that countries that actively invest in human capital development, such as Austria and the Netherlands, achieve prominent economic growth rates and have competitive advantages in the global market. In the context of constant change and competition at the global level, human capital is becoming one of the key factors determining the success of enterprises, especially in the creative industries. An essential aspect is the integration of education and innovative approaches into the practical activities of enterprises, which allows them to create new products, technologies and services that meet international standards.

Ukraine is gradually moving closer to integrating the latest technologies and digital platforms into the agrarian sector. The use of platforms such as AgroPortal, AgroHub and E-Agriculture helps to improve communication between farmers, suppliers and consumers, as well as optimise management processes. It is also important to develop education for farmers, which includes not only traditional courses but also online learning using modern technologies, allowing farmers to gain relevant knowledge and improve their skills. Training programmes such as AgriAcademy help farmers to effectively use new digital tools and techniques, which leads to increased productivity and reduced costs.

Human capital development also greatly influences social responsibility and environmental sustainability. Improving the education and skills of employees allows for more efficient resource management, cost reduction and the introduction of sustainable technologies in production, which helps to preserve the

environment and increase the competitiveness of enterprises. Educated employees are also better equipped to adapt to climate change, which is a crucial aspect of sustainable development in the face of global environmental challenges.

Human capital is an integral part of the transformation of the agrarian sector in these countries. Investments in education, research and development, and the introduction of the latest technologies contribute to increasing the efficiency of agricultural production, promoting innovation, and ensuring sustainable economic development. Training programmes, cooperation between universities and businesses, and the introduction of digital platforms are the basis for the successful modernisation of the

agrarian sector in these countries, and the experience of the Netherlands, Austria and Ukraine can become a scientific and practical model for other countries seeking to achieve sustainable development in the agrarian sphere. Prospects for further research include the investigation of the effects of human capital on the introduction of innovative technologies and sustainable development of the agrarian sector, particularly through digitalisation and innovation.

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CONFLICT OF INTEREST

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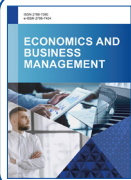
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Розвиток людського капіталу в умовах становлення креативної економіки

Анотація. Метою даного дослідження було проаналізувати роль людського капіталу у розвитку креативної економіки, зокрема через впровадження інновацій та розвиток освіти. Методологія дослідження включала використання аналізу сильних, слабких сторін, можливостей та загроз, а також вивчення інноваційних програм та освітніх ініціатив. Основні результати дослідження показали, що інвестиції в освіту та технології є важливим фактором для розвитку інновацій у креативних галузях. Дослідження платформ AgroPortal, E-Agriculture та AgroHub засвідчило їхню ефективність у покращенні комунікації між фермерами, постачальниками та споживачами, що сприяє оптимізації логістичних процесів і розвитку нових бізнес-моделей для онлайн-продажів. Виявлено, що впровадження цифрових технологій та розвиток програм навчання дозволяють значно покращити продуктивність і знизити витрати в аграрному секторі економіки. Крім того, було встановлено, що застосування цифрових рішень допомагає адаптувати аграрний сектор

до умов зміни клімату та глобальних проблем навколишнього середовища. Результати дослідження підтвердили, що людський капітал відіграє ключову роль у впровадженні інновацій та розвитку аграрного сектору. Особливе значення мають інвестиції в підготовку фахівців через сучасні освітні програми та тренінги, які дають аграріям можливість опанувати новітні технології та ефективні бізнес-стратегії. Аналіз виявив перспективи вдосконалення шляхом стратегічного використання існуючих цифрових платформ і навчальних курсів для підвищення потенціалу людського капіталу. Було приділено увагу платформам в Австрії, таким як Pramoium та myAsker, які демонструють успішну інтеграцію цифрових технологій у аграрний сектор. Аналіз освітніх програм і співпраці між університетами, бізнесом і державними установами в Нідерландах виявив їх важливу роль у підтримці сталого розвитку аграрного сектору, зокрема через такі проекти як «Ферма майбутнього». Висновки вказують на необхідність подальших інвестицій у розвиток людського капіталу через освітні програми і науково-дослідницьку діяльність, а також інтеграцію новітніх цифрових технологій в аграрний сектор економіки для забезпечення сталого розвитку креативної економіки. Врахування цих факторів дозволить покращити економічну ситуацію, підвищити ефективність виробництва та сприяти сталому розвитку національної економіки

Ключові слова: інновації; освітні програми; стійкість; конкурентоспроможність; людський капітал; розвиток; аграрний сектор економіки



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Innovative approaches to marketing management in Ukrainian farms

Abstract. The relevance of this study stems from the need to enhance the effectiveness of marketing activities in Ukrainian farming enterprises in the context of globalisation, digitalisation, and external threats. This article aimed to justify the implementation of innovative approaches to marketing management in order to increase the competitiveness of these enterprises. The research employed methods of comparative analysis, a systems approach, SWOT analysis, and generalisation. The study substantiates the feasibility of adopting digital marketing, e-commerce, branding, social media, CRM systems, and automated platforms for consumer communication. It also examines current challenges faced by farming enterprises in Ukraine, including declining purchasing power, disrupted logistics chains, and limited access to financing and marketing infrastructure. A SWOT analysis was conducted to identify the strengths and weaknesses of farming enterprises, as well as the external opportunities and threats influencing the implementation of marketing strategies. The study justifies the adoption of digital marketing, e-commerce, branding, social media, CRM systems, and automated platforms for consumer communication. Attention is also given to key aspects of marketing strategy transformation in response to shifts in the agricultural market environment. The role of information and communication technologies is defined as a tool for equipping farming enterprises with the necessary resources to support efficient production and sales operations. Contemporary marketing approaches are systematised, with an emphasis on the active use of digital promotion channels under martial law conditions. The practical significance of the findings lies in their potential application to the improvement of marketing strategies within farming enterprises, agricultural associations, and regional programmes aimed at supporting rural entrepreneurship

Keywords: digital marketing; competitiveness; agricultural sector; marketing strategies; SWOT analysis

INTRODUCTION

Amidst the ongoing military aggression and economic crisis, Ukrainian farms have encountered a range of challenges, including disrupted

logistics, loss of markets, resource scarcity, and threats to production. In these circumstances, the implementation of innovative marketing

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management is particularly pertinent as a tool for adapting to new socio-economic conditions.

The theoretical and applied aspects of implementing innovations in the marketing activities of farms have been explored in the studies of scholars such as Ye.O. Holyshcheva (2021), who emphasised the necessity of forming an adaptive marketing policy in conditions of economic uncertainty. The author noted that the use of innovative marketing instruments allows for quicker reaction to external environmental challenges and the preservation of market positions. The research of Y.I. Danko (2017) highlighted the importance of digital technologies in promoting agricultural produce, especially for small and medium-sized farms. The authors identify the competitive foundations of innovative marketing activity and emphasise that the effective use of digital tools is key to survival in conditions of market instability. E.V. Hnitytskyi (2017), in his research, focused on the analysis of applying Big Data in marketing strategies, with an emphasis on consumer orientation. He argues that the use of big data allows farmers to better understand consumer behaviour and personalise marketing approaches. The study by I.I. Polishchuk (2021) examined the implementation of customer relationship management (CRM) systems as an important instrument of modern marketing management in the agricultural sector, particularly in farming enterprises. The author stresses that in conditions of high competition and volatile market conjuncture, the ability of farming enterprises to build stable and personalised relationships with clients is the key to their sustainable development.

In their research, S.I. Melnyk *et al.* (2021) analysed the investment activity of agricultural enterprises in the context of dynamic external environment transformations, particularly those related to political, economic, and social changes. The authors underscored that the ability of enterprises to attract investment is directly dependent on their level of innovative openness and readiness for digital modernisation. Particular attention was paid to the role of institutional factors that shape a favourable or hindering environment for implementing innovations, especially in the sphere of marketing strategies. The article emphasises that active adaptation to

changes through the application of innovative approaches in marketing allows agricultural enterprises not only to maintain stability but also to build competitive advantages. In the study of T.V. Yanchuk & O.Yu. Boienko (2023), the main focus was on the implementation of CRM systems in the marketing activities of farms to increase their effectiveness. The authors highlighted the practical aspect of implementing such systems as a means of optimising sales and improving customer service. O.P. Lucii & O.M. Skakun (2023) examined the possibilities of using internet marketing as one of the key factors in enhancing the effectiveness of sales activities of agricultural enterprises. The authors emphasise that in the context of dynamic market digitalisation, especially considering the processes of European integration, agribusiness must actively utilise e-commerce tools to maintain competitiveness. The article analyses the advantages of tools such as SEO promotion, targeting, traffic analytics, the use of social media and marketplaces, which allow for reducing intermediary costs, expanding sales geography, and establishing direct contact with the end consumer.

All the aforementioned studies provide a solid theoretical and methodological basis for further scientific inquiry in the field of innovative marketing within the agricultural sector. At the same time, despite significant contributions to the development of specific aspects of the topic, a comprehensive study of the implementation of innovations in marketing management for farming enterprises remains relevant and requires in-depth investigation, particularly in the context of digital transformation and global challenges. In light of this, the present article aimed to provide a scientific understanding of the possibilities for applying innovative marketing approaches in the activities of farming enterprises that would address current economic challenges and contribute to the recovery and further development of the agricultural sector during martial law and in the postconflict economy.

MATERIALS AND METHODS

The methodological basis of this research was the use of a complex of general scientific (analysis of scholarly sources) and specialised methods (SWOT analysis), which enabled a holistic,

systematic, and scientifically grounded study of innovative approaches to marketing management in Ukrainian farms. This approach allowed for the analysis of both the internal aspects of agricultural enterprises' functioning and the external factors influencing their marketing activity in the context of dynamic transformations in the agricultural sector, driven by economic, technological, and socio-political changes.

The factual basis of the research consisted of data from analytical reports of the National Institute for Strategic Studies (Khymynets & Nesterenko, 2021), as well as information from the official websites of industry associations and farmer unions (A new issue of the study "UKRAINE:..., 2024). Furthermore, data from thematic information resources were utilised, including AgroPortal.ua (Get now, pay later:..., 2024), Latifundist.com (AgroForecasts 2024:..., 2024), Kurkul.com (Agritechnica will present innovative solutions..., 2023), SuperAgronom.com (Farming in Ukraine may..., 2024), which contain up-to-date analytical reviews, expert opinions, survey results, and examples of innovation implementation in agricultural marketing.

To gain a theoretical understanding of the issues surrounding innovative marketing, scholarly approaches in the field of marketing management for agricultural enterprises were synthesised, which allowed for outlining current directions of innovative activity. An important research tool was the SWOT analysis, which was used to assess the internal potential of farms (strengths and weaknesses) and the external environment (opportunities and threats) influencing the effectiveness of implementing innovative marketing strategies.

The formulation of conclusions and proposals was carried out based on the abstract-logical method, which ensured the generalisation of the results obtained, the identification of trends, and the development of practically oriented recommendations for improving the marketing activities of agricultural business entities.

RESULTS AND DISCUSSION

Innovative marketing methods and instruments serve as a key element in ensuring the successful functioning of agricultural enterprises amidst the economy's transformational development.

Given the rapid intensification of competition and the constant change in market conditions under the influence of globalisation processes, the application of innovations in the marketing sphere is considered a decisive factor in increasing competitiveness and enhancing the efficiency of agricultural business. The use of modern digital technologies, the latest communication platforms, and adaptive promotion techniques allows not only for prompt reaction to external challenges but also for shaping new consumer expectations, creating unique value for target markets. This, in turn, ensures both short-term profitability and strategic sustainability and development of economic entities in the long term.

However, a significant proportion of enterprises in Ukraine's agricultural sector, including farms, face several systemic barriers to innovation implementation. Among the key factors hindering the development of innovative activity are: the absence of stable and consistent state policy supporting innovations; limited financial resources; imperfections in the regulatory framework for stimulating the innovation environment; insufficient qualification levels of managerial staff; low economic motivation; depreciation of material and technical assets; and the underdeveloped nature of marketing structures that could ensure strategic planning of innovative activities (Ilchenko, 2024).

In the context of intensifying global competition, the necessity for activating and systematising the innovative development of agricultural enterprises becomes objective. An effective model of innovative development for farms should be based on a comprehensive approach that involves the integration of biological, technical, economic, marketing, social, organisational, managerial, and legal innovations as interconnected components of a unified modernisation strategy (Fig. 1).

One of the key advantages of implementing innovations in the marketing activities of farms is the capacity for more accurate and well-founded analysis of the market environment. In particular, the application of analytical platforms and Big Data processing technologies provides a deep understanding of consumer behaviour, customer preferences, and current demand trends.

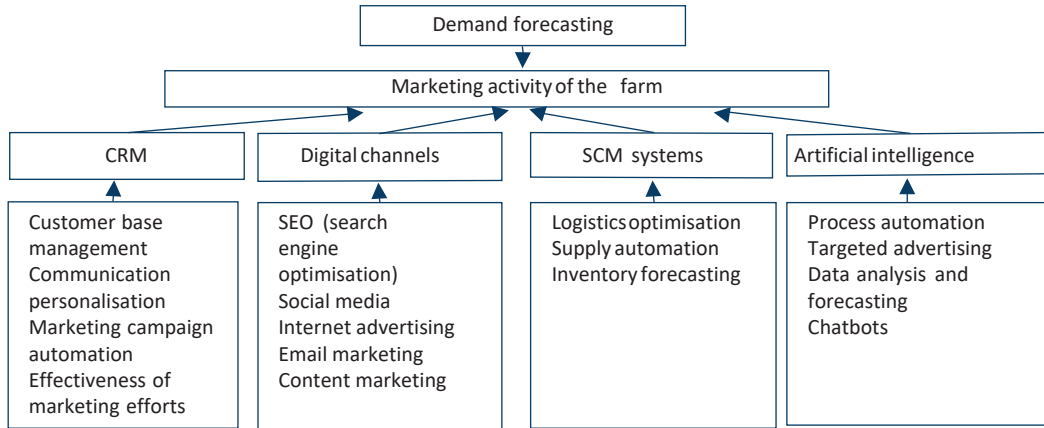


Figure 1. Innovative instruments for ensuring the effectiveness of marketing activities in farm-type agricultural enterprises

Source: developed by the author based on T. Ilchenko (2024)

The armed aggression by Russia has significantly exacerbated existing problems in Ukraine's agricultural sector. According to the results of a survey conducted by the Ukrainian Business Council jointly with the Help – Hilfe zur Selbsthilfe organisation in January 2023, 20.75% of respondents characterised the current state of their agribusiness as critical or unsatisfactory, 50% as satisfactory, while only 21.25% assessed it as good (Conclusion based on the results..., n.d.). In these circumstances, overcoming challenges, ensuring viability, and seeking prospects for the further development of farms requires the implementation of innovations, proactive management, and effective strategic decisions.

Amidst current challenges, one of the priority tasks for Ukraine is to provide comprehensive support for the development of farms, which constitute an important component of the national agro-industrial complex. The area of individual farms can exceed one million hectares, indicating the scale of agricultural production. Ukraine holds leading positions in global exports of barley, maize, rapeseed, and wheat, and is also the largest producer of sunflower oil. Furthermore, the supply of Ukrainian agricultural produce is critically important for the food security of some of the world's poorest countries, which are largely dependent on imports from Ukraine (Conclusion based on the results..., n.d.).

Thus, in 2024, the share of agricultural products in Ukraine's foreign trade structure accounted for 59%, indicating their key role in the country's export potential. Sunflower oil held the most significant position among exported goods – 6 million tonnes of this product were supplied abroad, valued at 5.1 billion USD, which constitutes 21% of the total export volume. Maize secured an identical share (21%), with its export volume reaching 29.6 million tonnes and generating 5 billion USD in revenue. Wheat ranked third by export value – 20.6 million tonnes worth 3.7 billion USD, corresponding to 15% of total exports. Among other significant agricultural export items, it is worth noting rapeseed (7%, or 3.8 million tonnes valued at 1.8 billion USD), soybeans (5%, or 3.4 million tonnes valued at 1.3 billion USD), as well as oilcake and other residues from the processing of oilseeds (4%, or 4.7 million tonnes valued at 1 billion USD) (Ukraine exported over 67 million tons..., 2024).

For Ukrainian farmers to maintain and strengthen their leading positions in the global agricultural market amidst increasing competition and global challenges, it is extremely important not only to sustain production volumes but also to adapt to new market requirements. One of the key factors in such adaptation is the digital transformation of the agricultural sector, which allows for increased management efficiency, improved access to sales markets, and

ensures flexibility in responding to changes in consumer preferences. The implementation of digital technologies in the marketing activities of farms, in particular, becomes an important tool for ensuring their competitiveness in both domestic and international markets.

The application of digital tools, the Internet, and social media provides agricultural enterprises with the opportunity for effective communication with consumers, increasing their interest and building stable relationships. In turn, the development of e-commerce creates conditions for direct sales of agricultural produce from producer to final consumer, which allows for minimising the involvement of intermediaries and increasing the efficiency of logistics processes.

The use of analytical tools and artificial intelligence systems provides agricultural enterprises with the ability to process large volumes of data, forecast market trends, and respond promptly to changes in consumer demand and production conditions. This approach contributes to increased accuracy in demand forecasting, reduced production costs, and minimisation of risks. Furthermore, there is growing attention within the agricultural sector to the implementation of the concept of sustainable development, which involves the production of environmentally safe products. Integrating principles of ecological responsibility into the marketing strategy of farms ensures the attraction of environmentally conscious consumers and the formation of a positive brand image in the market. Innovative approaches to marketing management in farms are viewed not as a one-off tool for increasing sales volumes or attracting new consumers, but as a continuous and systematic process. The effectiveness of implementing marketing strategies in the activities of farms is only ensured under the condition of their consistent and sustainable application.

Modern technological advancements in agriculture correspond to the growing needs for increased automation, digitalisation, and ecological feasibility in the functioning of farms. Current trends in the development of the agricultural sector indicate a gradual transition towards the concept of “smart farming”, which involves efficient management of resources

and time while simultaneously minimising crop losses. Smart farming is a promising direction based on the implementation of innovative technologies, including the Internet of Things (IoT), computer vision, and artificial intelligence (AI), in agricultural production processes (Top 10 trends, technologies and innovations..., 2022).

Farms are increasingly integrating digital technologies, including satellite monitoring, field sensors, remote data collection systems, and artificial intelligence, to adapt to new agribusiness conditions. Given that over 40% of agricultural land is temporarily unsuitable for use and logistics chains and infrastructure have suffered significant damage, the use of technology has become a key tool for preserving production and managing risks. Particular attention is paid to the rational use of scarce resources and ensuring the safety of workers (Conclusion based on the results..., n.d.).

Additionally, new-generation digital services, particularly AI-based software complexes (for instance, platforms like Cropwise), provide comprehensive monitoring of machinery and crops, enable optimisation of agrochemical usage, and enhance the efficiency of production processes. These tools also contribute to building a flexible and adaptive management system for farms during both wartime and the post-war periods (Baker *et al.*, 2017).

Cybernetics, traditionally applied to control the processes of growing and storing agricultural products, is considered in modern conditions as an important instrument for decision support in systems for monitoring and optimising agricultural production. Specifically, its use contributes to increasing yields by facilitating informed decisions regarding key technological operations: sowing, irrigation, fertilisation, pesticide application, and harvesting. Thanks to the ability to assess the current state of production systems and forecast the impact of key factors such as soil quality, weather conditions, and climate change, cybernetic approaches help to increase the accuracy of agricultural process management (Emerick & Dar, 2021).

Specifically, another key source of data for the digitalisation of processes in farms is the implementation of sensor technologies. Unlike traditional monitoring systems, modern

sensors are capable of operating wirelessly, providing continuous tracking of a wide range of structured data, including temperature readings, pressure levels, movement, and so forth (Streuer, 2020). The application of such devices allows for remote control of technological processes, such as automated irrigation (Fischer *et al.*, 2019), variable rate tillage technologies, and autonomous control of agricultural machinery (Kulkarni *et al.*, 2020). As examples of practical implementation demonstrate, sensor devices are an integral component of modern robotic systems that enable the execution of operations activated by robotic elements.

Thanks to robotic sensing, it has become possible to detect weeds, localise fruits, control feeding, and assess potential yields. The data obtained are subjected to in-depth analysis and used for making decisions regarding the application of herbicides, harvesting ripe fruits, or carrying out irrigation (Davis & Bendickson, 2020). The implementation of innovative approaches to marketing management based on digital technologies has a positive impact on the efficiency of farming enterprises in Ukraine. The shift from predominantly manual labour to more cognitive activity facilitates higher quality information-based decisions, optimises production processes, increases the reliability of agricultural systems, and ensures consistently high yields (Baker *et al.*, 2017).

In this context, the use of Big Data technologies acquires particular significance, being considered among the most promising information solutions for the development of farming enterprises (Kulkarni *et al.*, 2020). The concept of Big Data encompasses large-volume and heterogeneous datasets, as well as modern methods for their storage, analysis, and visualisation (Fischer *et al.*, 2019). These tools allow for obtaining new knowledge in near real-time that was previously inaccessible (Gosnell *et al.*, 2019). Integrating data from various sources – including information on consumer behaviour, their preferences, and demand dynamics – forms the analytical basis for making effective management decisions in agriculture.

Furthermore, Big Data technologies enable in-depth analysis of large volumes of market information, including consumer behavioural

patterns and competitor actions, which creates an analytical foundation for developing effective marketing strategies. Specifically, the analysis of collected data allows for forecasting changes in consumer demand for agricultural products, ensuring a prompt response from farms to changing market conditions. Additionally, the implementation of artificial intelligence in marketing management processes allows for the automation of a range of tasks, such as processing customer inquiries or setting up targeted advertising, which contributes to resource savings and increased effectiveness of management decisions (Reznik *et al.*, 2023).

In contemporary agricultural business conditions, the competitiveness of enterprises is largely determined by the effectiveness of marketing communications, primarily oriented towards satisfying consumer needs. Recognising the key role of clients as the main factor in business success is an important prerequisite for increasing the performance of farming enterprises. In this context, the implementation of customer relationship management (CRM) systems becomes a vital tool, ensuring the formation of stable and personalised relationships with consumers. The application of CRM technologies allows for the automation of communication processes, the adaptation of marketing strategies to individual client characteristics, and, consequently, an increase in the overall effectiveness of the farm's marketing activities (Ilchenko, 2024).

One of the key directions for implementing innovations in the marketing activities of farms is the use of digital communication channels. This includes, specifically, the application of social media, internet advertising, content marketing, and search engine optimisation (SEO) technologies. Digital marketing tools create conditions for expanding the target audience, including potential foreign consumers, and contribute to ensuring interactive engagement with clients. For farms, this opens up prospects for creating multilingual e-commerce platforms, which allow for the activation of export activities and the expansion of product sales geography (Dulska, 2015; Morokhova & Boiko, 2023).

An important aspect in the context of digital transformation is also the optimisation of

logistics processes. The application of automated supply chain management (SCM) systems enables the reduction of transportation costs, the shortening of delivery times, and the improvement of customer service quality (Ilchenko, 2024). Modern SCM solutions integrate all stages of the logistics process – from raw material procurement to the delivery of finished products to the final consumer – ensuring transparency and control at each stage. This, in turn, enhances the ability of farms to respond promptly to changes in demand, reduces the risks of logistical delays, and contributes to increased supply reliability. Hence, the implementation of SCM systems is an important condition for ensuring effective logistics management in agribusiness.

Another promising innovative direction for improving the marketing activities of farms is the development of content marketing. In the digital era, high-quality content is becoming the

primary tool for effective communication with the target audience (Lucii & Skakun, 2023). Agricultural enterprises can enhance their visibility in the digital environment by creating expert publications, video reviews of products, conducting webinars, preparing analytical reports, and so forth. For example, articles highlighting the competitive advantages of products or video materials demonstrating their quality build a positive brand image. Effective promotion also involves the active use of social media, targeted advertising on platforms such as LinkedIn, Facebook, and Google Ads, and regularly updating the information content of agricultural enterprises' websites and blogs.

In the context of implementing innovative approaches to marketing management in farms, SWOT analysis (Table 1) acquires particular significance as a tool for strategic analysis of the enterprise's external and internal environment.

Table 1. SWOT analysis of innovative marketing management in Ukrainian farms

Strengths	Weaknesses
Use of digital technologies (Big Data, CRM, artificial intelligence) to enhance marketing effectiveness	High costs are associated with implementing innovative technologies
Potential for personalised interaction with clients	Low level of digital literacy among employees
Automation of consumer demand analysis processes	Limited access to modern technical equipment in certain regions
Prompt marketing decision-making based on analytical data	Insufficient experience in managing complex information systems
Opportunities	Threats
Entry into new market segments through digital promotion channels	Increased competition from large agricultural holdings
Building long-term relationships with clients through omnichannel communications	Cybersecurity and personal data leakage risks
Increased effectiveness of advertising campaigns through targeting and analytics	Macroeconomic instability (inflation, war)
Attracting investments for the development of innovative projects	Risks associated with legislative changes in the sphere of digital transformation

Source: developed by the author based on T. Ilchenko (2024)

Thus, the SWOT analysis allows for the identification of both strengths that should be developed and risks that need to be minimised through strategic planning and the adaptation of marketing approaches to contemporary digital conditions. In the process of researching the readiness of farms for implementing innovations, particularly of a digital nature, it has been established that different key factors

influencing the organisational capacity of agricultural enterprises for innovative changes become relevant at various stages of this process. Of particular importance in this regard is the necessity of developing and implementing measures at the national level aimed at fostering relevant knowledge in the field of digital technologies among farmers, as well as their practical implementation in economic activities.

To enhance the innovative capacity of farms, the following directions are advisable: creating a centralised knowledge base concerning digital technologies in agriculture and forming an innovation network accessible to agricultural entities; providing an analytical overview of the dynamics of the digital innovation readiness formation process to increase farmers' awareness regarding the complexity, sequence, and priority of these transformations. The implementation of modern digital technologies across all stages of farms' marketing activities contributes to ensuring their sustainable development and maintaining competitive positions in the agricultural sector.

Compared to other studies, the results of this analysis confirm the importance of implementing innovative approaches in the marketing activities of farms. Specifically, S. Koberniuk & V. Karpenko (2023) emphasised the necessity of implementing digital technologies in all aspects of marketing policy, including product, pricing, distribution, and product positioning in the market. This aligns with the authors' conclusions regarding the importance of integrating modern digital instruments into the marketing strategy of farms.

The approach proposed by I.I. Polishchuk (2021), who considered customer relationship management (CRM) systems as a key driver of business processes oriented towards forming and maintaining customer loyalty, is entirely acceptable. The author noted that CRM acts not only as software for automating marketing, sales, and service processes but as a holistic business management concept. According to her conviction, the use of CRM technologies contributes to the personalisation of customer interaction, increased effectiveness of marketing activities, and cost optimisation, which collectively ensure the growth of farm profitability through enhanced customer orientation and increased levels of consumer loyalty. This approach complements the results of the present study, underscoring the need for flexible and adaptive marketing management in an unstable market environment.

In turn, I.V. Dulaska (2015) viewed digital technologies as a powerful catalyst for economic growth in the agricultural sector, emphasising

the importance of the institutional environment for their effective implementation. The author pointed to the necessity of creating regulatory and organisational conditions that would stimulate the innovative activity of farms, particularly through financial instruments supporting digitalisation. I.V. Dulaska substantiated that the integration of digital technologies into farmers' marketing activities opens up new possibilities for more effective interaction with markets, cost reduction, and improved logistics for product sales.

The research by S. Nazarenko *et al.* (2024) examined innovative approaches to management and communications in modern agro-industrial enterprises. They focus on the implementation of digital technologies, such as ERP systems, Big Data analysis, and blockchain technologies, to enhance the efficiency of management and production processes. These aspects complement the conclusions regarding the importance of implementing digital technologies in the management of farms.

Additionally, according to the position of E.V. Hnitetskyi (2017), the application of Big Data tools in the process of planning and adjusting marketing activities provides significant advantages for both producers and consumers. This approach is consistent with the present study and contributes to the optimisation of marketing activities, cost reduction, and increased efficiency, while also allowing for the establishment of long-term partnerships with consumers, thanks to the flexibility of the marketing mix by individual client requests.

Researchers D. Zmievets & L. Pronko (2024) analysed the challenges and opportunities of innovative marketing for agricultural enterprises during martial law in Ukraine. They emphasise the role of information and communication technologies in providing agricultural enterprises with the necessary resources for conducting effective activities. The conclusions of these researchers are consistent with the results of the submitted study, which highlight the necessity of adapting marketing strategies to changing market conditions.

In the research by T. Ilchenko (2024), the specifics of using innovative approaches to improving marketing activities in agribusiness were examined. T. Ilchenko identified the

necessity of seeking new innovative mechanisms and tools that will ensure the formation of competitive advantages for agricultural enterprises, including farms. These aspects complement the authors' conclusions regarding the barriers to implementing innovations in the marketing management of farms.

Thus, a comparative analysis of the results of the present study with the articles of other authors confirms the importance of integrating innovative and digital technologies into the marketing management of farms. Common conclusions relate to the necessity of a strategic approach, adaptation to changing market conditions, and overcoming barriers to innovation implementation. The differences, however, lie in the focus of the research: some authors concentrate on specific aspects, such as sales activities or communications management, while the present study covers a broader spectrum of issues related to the implementation of innovative management methods in the marketing activities of farms.

CONCLUSIONS

The concept of innovative marketing management for farms is based on three fundamental aspects: the implementation of modern technological solutions, the optimisation of business processes, and the intensification of using digital communication channels. The implementation of this approach is aimed at ensuring the long-term development of farms in conditions of increasing competitive struggle at local and international levels.

Within the scope of the research, it was established that the most effective innovative solutions for farms are: the implementation of CRM systems for automating work with clients, the use of digital marketing with an emphasis on social media and geotargeting, and the application of analytical platforms for real-time market monitoring. It was determined that the integration of precisely such tools allows for

increasing production profitability, thanks to more accurate demand forecasting, optimisation of sales channels, and increased levels of client engagement. Successful implementation of digital marketing management tools requires the technologies to be suitable for the specific functioning of the farm, their compatibility with the existing IT infrastructure, and a prior assessment of the expected economic efficiency. It was determined that to enhance the innovative capacity of farms, it is advisable to implement the following measures: create a centralised knowledge base regarding the application of digital technologies in agriculture and develop an innovation network open to agricultural entities; ensure a systematic analytical overview of the dynamics of forming readiness for digital innovation implementation, which will allow farmers to better understand the complexity, stages, and priority of these transformations. The integration of modern digital technologies at all stages of farms' marketing activities will contribute to their sustainable development and the strengthening of their competitiveness in the modern agricultural market.

However, limited financial and time resources, a lack of adequate state support, and a low level of digital literacy remain key barriers. The research results confirm the necessity of systemic support from the state, technology providers, and the scientific community. Further research should appropriately be directed towards a comparative analysis of the agricultural sector's innovative readiness with other sectors of the national economy, which will facilitate the development of effective mechanisms for integrating innovations into the economic activities of farming enterprises.

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CONFLICT OF INTEREST

None.

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Інноваційні підходи до управління маркетинговою діяльністю у фермерських господарствах України

Анотація. Актуальність дослідження зумовлена необхідністю підвищення ефективності маркетингової діяльності фермерських господарств України в умовах глобалізації, цифровізації та зовнішніх загроз. Метою статті було обґрунтування впровадження інноваційних підходів до управління маркетинговою діяльністю фермерських господарств з метою підвищення їх конкурентоспроможності. У дослідженні використано методи порівняльного аналізу, системного підходу, SWOT-аналізу та узагальнення. У роботі обґрунтовано доцільність впровадження цифрового маркетингу, електронної комерції, брендингу, соціальних мереж, CRM-систем, автоматизованих платформ для комунікації зі споживачами. У роботі проаналізовано сучасні виклики, з якими стикаються фермерські господарства в Україні, зокрема зниження платоспроможного попиту, порушення логістичних ланцюгів, обмежений доступ до фінансування та маркетингової інфраструктури. Було проведено SWOT-аналіз, який дозволив охарактеризувати сильні й слабкі сторони господарств, а також зовнішні можливості й загрози для реалізації маркетингових стратегій. Обґрунтовано доцільність впровадження цифрового маркетингу, електронної комерції, брендингу, соціальних мереж, CRM-систем, автоматизованих платформ для комунікації зі споживачами. Також у дослідженні було приділено увагу ключовим аспектам трансформації маркетингових стратегій відповідно до змін кон'юнктури аграрного ринку. Визначено роль інформаційно-комунікаційних технологій як інструменту забезпечення фермерських господарств необхідними ресурсами для реалізації ефективної виробничо-збутової діяльності. Систематизовано сучасні підходи до маркетингу, що передбачають активне використання цифрових каналів просування продукції в умовах воєнного стану. Практичне значення результатів полягає в можливості їх використання для вдосконалення маркетингових стратегій фермерських господарств, аграрних об'єднань і регіональних програм підтримки сільського підприємництва

Ключові слова: цифровий маркетинг; конкурентоспроможність; аграрний сектор; маркетингові стратегії; SWOT-аналіз

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