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ACCOUNTING AND ANALYTICAL SUPPORT FOR THE AUDIT OF PRODUCTION AND EXPORT OF CROP PRODUCTS AT AN AGRIBUSINESS ENTERPRISES

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ОБЛІКОВО-АНАЛІТИЧНЕ ЗАБЕЗПЕЧЕННЯ АУДИТУ ВИРОБНИЦТВА ТА ЕКСПОРТУ ПРОДУКЦІЇ РОСЛИННИЦТВА ПІДПРИЄМСТВАМИ АГРОБІЗНЕСУ

Introduction. The article provides a theoretical and methodological substantiation and conceptualization of accounting and analytical support for the audit of production and export of crop products under conditions of digital transformation of agribusiness and growing global uncertainty.

It is substantiated that the modern development of the agricultural sector is characterized by the simultaneous complication of production processes caused by the biological nature of assets, as well as by the expansion of export-oriented activities accompanied by an increased level of currency, logistics, and regulatory risks. It is proved that under such conditions, traditional approaches to the formation of accounting and analytical information focused on retrospective reflection of business operations do not provide an adequate level of information support for audit.

It is determined that the key prerequisite for increasing audit efficiency is the transformation of accounting and analytical support into an integrated digitally oriented system capable of ensuring the formation, processing, and verification of information in a mode close to real time. Such a system should perform not only an informational function, but also an analytical and forecasting function, ensuring risk identification and support for managerial decision-making.

Purpose. The purpose of the study is to develop a conceptual model of accounting and analytical support for the audit of production and export of crop products of agribusiness enterprises based on the principles of integration, adaptability, and risk orientation.

Methods. The methodological basis of the study is a systems approach, which made it possible to consider accounting and analytical support as a multi-level integrated system combining accounting, analytical, and control subsystems. In the course of the study, methods of theoretical generalization, analysis and synthesis, comparative analysis, economic and statistical methods, as well as digital analytics tools, including Big Data, machine learning, and automated audit, were used.

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Results. As a result of the study, a conceptual model of accounting and analytical support for audit was developed, which provides for the integration of financial, management, and tax accounting in a single digital environment using intelligent data analysis tools. It is proved that the implementation of the proposed model ensures an increase in the reliability of accounting information, the efficiency of audit procedures, and the level of information transparency of agribusiness enterprises.

The study identifies key directions for the development of accounting and analytical support for audit are the introduction of continuous auditing technologies, the use of artificial intelligence for risk identification, ensuring product traceability, and the integration of ESG indicators into the system of analytical evaluation of enterprise performance.

Practical implications. The practical significance of the obtained results lies in the possibility of using the proposed model to improve the efficiency of internal audit, enhance risk management of foreign economic activity, and ensure the competitiveness of agribusiness enterprises in international markets.

Originality / Scientific novelty. A model combining ERP systems, satellite monitoring, and blockchain traceability of export batches, integrating financial, management, and tax accounting in a single digital environment, is proposed; the approach to forming information support for audit on the basis of risk orientation has been improved, which makes it possible to identify critical zones of production and export activity; the theoretical substantiation of the role of the accounting and analytical system as a tool of proactive audit using digital technologies and data analytics has been further developed; the integration of digital audit tools (Big Data, artificial intelligence, automated control) into the process of auditing export operations has been proposed; the expediency of using product traceability technologies as a component of increasing the reliability of audit reports has been substantiated.

Вступ. У статті здійснено теоретико-методичне обгрунтування та концептуалізацію обліково-аналітичного забезпечення аудиту виробництва та експорту продукції рослинництва в умовах цифрової трансформації агробізнесу та зростання глобальної невизначеності.

Обгрунтовано, що сучасний розвиток аграрного сектору характеризується одночасним ускладненням виробничих процесів, зумовлених біологічною природою активів, та розширенням експортно-орієнтованої діяльності, яка супроводжується підвищеним рівнем валютних, логістичних і регуляторних ризиків. Доведено, що в таких умовах традиційні підходи до формування обліково-аналітичної інформації, орієнтовані на ретроспективне відображення господарських операцій, не забезпечують належного рівня інформаційної підтримки аудиту.

Визначено, що ключовою передумовою підвищення ефективності аудиту є трансформація обліково-аналітичного забезпечення у інтегровану цифрову орієнтовану систему, здатну забезпечувати формування, обробку та верифікацію інформації у режимі, наближеному до реального часу. Така система має виконувати не лише інформаційну, а й аналітико-прогностичну функцію, забезпечуючи ідентифікацію ризиків та підтримку управлінських рішень.

Мета. Метою дослідження є розробка концептуальної моделі обліково-аналітичного забезпечення аудиту виробництва та експорту продукції рослинництва підприємств агробізнесу, яка базується на принципах інтегрованості, адаптивності та ризик-орієнтованості.

Методологічну основу дослідження становить системний підхід, який дозволив розглядати обліково-аналітичне забезпечення як багаторівневу інтегровану систему, що поєднує облікову, аналітичну та контрольну підсистеми. У процесі дослідження використано методи теоретичного узагальнення, аналізу і синтезу, порівняльного аналізу, економіко-статистичні методи, а також інструменти цифрової аналітики, зокрема Big Data, машинного навчання та автоматизованого аудиту.

У результаті дослідження розроблено концептуальну модель обліково-аналітичного забезпечення аудиту, яка передбачає інтеграцію фінансового, управлінського та податкового обліку в єдиному цифровому середовищі з використанням інструментів інтелектуального аналізу даних. Доведено, що впровадження запропонованої моделі забезпечує підвищення достовірності облікової інформації, ефективності аудиторських процедур та рівня інформаційної прозорості підприємств агробізнесу.

Встановлено, що ключовими напрямами розвитку обліково-аналітичного забезпечення аудиту є впровадження технологій безперервного аудиту, використання штучного інтелекту для ідентифікації ризиків, забезпечення простежуваності продукції та інтеграція ESG-індикаторів у систему аналітичного оцінювання діяльності підприємств.

Практичне значення отриманих результатів полягає у можливості використання запропонованої моделі для підвищення ефективності внутрішнього аудиту, удосконалення управління ризиками зовнішньоекономічної діяльності та забезпечення конкурентоспроможності підприємств агробізнесу на міжнародних ринках..

Наукова новизна. Запропоновано модель, що поєднує ERP-системи, супутниковий моніторинг та блокчейн-простежуваності експортних партій, що поєднує фінансовий, управлінський та податковий облік у єдиному цифровому середовищі; удосконалено підхід до формування інформаційного забезпечення аудиту на засадах ризик-орієнтованості, що дозволяє ідентифікувати критичні зони виробничо-експортної діяльності; набуло подальшого розвитку теоретичне обгрунтування ролі обліково-аналітичної системи як інструменту проактивного аудиту із застосуванням цифрових технологій та аналітики даних; запропоновано інтеграцію інструментів цифрового аудиту (Big Data, штучний інтелект, автоматизований контроль) у процес перевірки експортних операцій; обгрунтовано доцільність використання технологій простежуваності продукції як складової підвищення достовірності аудиторських звітів.

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Практична значущість. Практична значущість результатів дослідження полягає у можливості: впровадження інтегрованої моделі обліково-аналітичного забезпечення у діяльність підприємств агробізнесу; підвищення якості та достовірності облікової інформації для потреб аудиту; оптимізації аудиторських процедур на основі цифрових технологій; удосконалення системи управління ризиками експортної діяльності; використання результатів у навчальному процесі при підготовці фахівців з обліку, аудиту та аграрного менеджменту.

Key words: accounting and analytical support; audit; production; foreign economic activity; export; crop products; risk-oriented audit; digital audit; Big Data; artificial intelligence; ESG reporting; agribusiness enterprise.

Ключові слова: обліково-аналітичне забезпечення; аудит; виробництво; зовнішньоекономічна діяльність; експорт; імпорт; продукція рослинництва; ризик-орієнтований аудит; digital аудит; Big Data; штучний інтелект; ESG-звітність; підприємство агробізнесу.

PROBLEM STATEMENT

The digital transformation of business and the active integration of agricultural sector enterprises into global supply chains significantly increase the requirements for the quality, transparency, and reliability of information support for their activities. The specifics of production processes in crop production, caused by the influence of natural and climatic factors, biological transformation of assets, and technological variability, form a complex multi-level structure of accounting data and increase the risk of their misstatement. At the same time, the strengthening of the export orientation of enterprises is accompanied by growing currency, logistics, and regulatory risks. This requires harmonization of the accounting and analytical systems of agricultural enterprises with international standards.

The practice of functioning of agribusiness enterprises indicates the presence of systemic problems, among which fragmentation of accounting and analytical systems, their orientation toward retrospective reflection of business operations, as well as an insufficient level of integration of accounting, analytical, and control subsystems dominate. This limits the possibilities of conducting a comprehensive audit of production and export of crop products and reduces the efficiency of risk identification and the validity of managerial decisions.

An additional constraining factor is the low level of implementation of digital technologies, in particular tools for big data analytics, automated control, and decision support systems, which makes continuous auditing impossible and complicates monitoring of production and export processes in real time.

Thus, the growing complexity of production and export processes and the increasing uncertainty of the external environment determine the need to form a holistic, adaptive, and risk-oriented approach to accounting and analytical support for audit based on the integration of digital technologies, intelligent analytics, and continuous control tools.

LITERATURE REVIEW

Modern scientific studies of 2025—2026 demonstrate a profound transformation of theoretical and applied approaches to the formation of accounting and analytical support and audit in the agricultural sector, caused by the digitalization of the economy, increasing requirements for sustainable development, and the integration of agribusiness into global value chains.

In particular, the study by P. Campos-Llerena (2025) [1] substantiates that the application of the international standard IAS 41 for the valuation of biological assets increases the relevance of accounting information, but at the same time generates additional risks of its misstatement related to the use of valuation judgments and the high volatility of biological transformations. This actualizes the need to strengthen the analytical component of audit and expand the tools for verification of accounting data.

Further development of scientific approaches is associated with the concept of Agriculture 5.0 (2026) [5], within which the digital transformation of the agricultural sector is considered a factor of radical change in the information architecture of enterprises. Researchers emphasize the need for real-time data integration, automation of control procedures, and the use of intelligent analytical systems, which indicates the limitations of traditional approaches to accounting and audit under the conditions of the digital economy.

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In the works of T. Yuan, X. Zhang, and X. Chen (2025) [2], the use of machine learning algorithms in financial audit is proposed, which makes it possible to identify anomalous and high-risk transactions with greater accuracy compared to classical methods. This confirms the tendency of transition from retrospective control to a proactive, risk-oriented audit model.

At the same time, the studies of R. Wang et al. (2025) [3] demonstrate the potential of applying large language models (LLMs) in the processes of automation of financial statement auditing, but emphasize their limitations, in particular insufficient ability for deep interpretation of the economic substance of transactions and ensuring regulatory compliance. This determines the necessity of combining digital tools with the professional judgment of the auditor.

The conceptual foundations of the transformation of accounting under conditions of the spread of artificial intelligence are disclosed in the study by T. Stratopoulos and V. Wang (2025) [4], where the expediency of integrating AI technologies into all stages of the accounting and analytical process is substantiated. The authors prove that the implementation of intelligent systems changes not only the tools, but also the paradigm of accounting science, transforming it toward an analytical and forecasting orientation.

A separate area of modern research is related to the integration of ESG factors into the accounting and auditing system. Studies of 2025 prove that the inclusion of environmental and social indicators in accounting and analytical systems creates new requirements for audit, in particular regarding the expansion of audit objects and increasing the level of information transparency of enterprises.

In the context of the development of agricultural exports, the study by O. Zhyhylii (2025) [11] is important, in which the influence of global challenges, logistical constraints, and regulatory changes on the structure of export operations of agribusiness is determined. The author substantiates the need to improve accounting and analytical mechanisms for controlling export activities as a prerequisite for increasing their efficiency.

At the same time, modern studies of audit in agriculture (2026) confirm that the sectoral specifics of agricultural assets, in particular their biological nature and dependence on external factors, require the adaptation of audit procedures and strengthening the role of analytical methods for risk assessment.

The generalization of scientific approaches makes it possible to distinguish the following key trends: transformation of accounting and audit under the influence of digital technologies (AI, Big Data); increasing complexity of the valuation of biological assets and related risks; transition to proactive, risk-oriented audit; integration of ESG indicators into the system of accounting and analytical support; strengthening requirements for control of export operations in agribusiness.

The practice of agribusiness enterprises indicates the presence of systemic problems. Among them are fragmentation of accounting and analytical systems and their orientation toward retrospective reflection of operations. There is also a low level of integration of accounting, analytical, and control subsystems.

MATERIALS AND METHODS

The information base of the study was formed as an integrated system of regulatory, analytical, and empirical sources covering acts on accounting, auditing, and foreign economic activity, provisions of international financial reporting standards, as well as analytical materials of international organizations. The empirical basis consists of data from financial, tax, and management reporting of agribusiness enterprises and generalized statistical indicators of production and export of crop products.

A specific feature of the information base is the combination of traditional accounting data with digital sources, in particular ERP systems, analytical platforms, and structured datasets of foreign economic activity, which ensures the expansion of the audit evidence base.

The methodological basis is a systems approach, according to which accounting and analytical support for audit is considered as an integrated system of accounting, analytical, and control components. The study used methods of theoretical generalization and scientific abstraction to clarify the essence of accounting and analytical support; analysis and synthesis to study the processes of formation and integration of information; comparative analysis to assess modern approaches; economic and statistical methods to study trends in production and export; methods of classification and grouping to systematize information flows.

The study applied tools of big data analytics, machine learning, continuous auditing, and natural language processing, as well as elements of functional and process modeling. ESG indicators were additionally integrated, which expands the analytical capabilities of audit. The comprehensive use of methods ensures the validity of the results and their practical applicability.

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MAIN RESULTS

The formation of effective accounting and analytical support for the audit of production and export of crop products is of decisive importance for ensuring the reliability of information, transparency of activities, and validity of managerial decisions.

The specifics of production processes in crop production are determined by natural and climatic factors, the biological transformation of assets, dependence on environmental conditions, and high variability of business results. This forms a complex structure of accounting data and increases the risk of their misstatement, resulting in complications in the process of forming a reliable accounting and analytical basis for audit.

Additionally, the export orientation of activities creates a complex of external risks related to currency fluctuations, logistical constraints, and the dynamics of international markets. Taken together, these factors create a multi-level risk environment that requires the application of integrated approaches to its assessment and control. In this context, accounting and analytical support should be considered not only as an instrument for reflecting business transactions, but as a comprehensive system capable of generating analytical information to support audit decisions.

For the purpose of systematizing the risks of production and export activities, the study proposes an author's scheme of the risk system of production and export activities of agribusiness enterprises, which reflects the key groups of risks and their interrelations (Table 1).

The proposed scheme makes it possible to identify critical risk zones, ensures coordination of accounting, analytical, and control processes, and forms the basis for building an integrated system of accounting and analytical support for audit. Its application ensures the systematization of risks and creates the basis for building an integrated audit system.

At the same time, the systematization of risks of production and export activities requires an in-depth analysis of their economic nature and influence on the formation of accounting information.

Under conditions of digital transformation of the economy, the traditional model of accounting and analytical support does not meet the practical requirements. This determines the need to move toward an integrated, dynamic model capable of functioning in a mode close to real time.

Taking into account these prerequisites, the authors developed a conceptual model of accounting and analytical support for the audit of production and export of crop products based on the principles of integration, adaptability, and risk orientation. The model provides for the formation of a single digital information environment within which interaction between accounting, analytical, and control processes is ensured. The basis of the conceptual model is the interaction of three contours: accounting, analytical, and control.

The accounting contour ensures the formation of primary information on production and export transactions taking into account the specifics of biological assets and foreign economic activity. The analytical contour performs processing, systematization, and interpretation of data using methods of economic analysis and digital analytics, creating the basis for efficiency assessment and identification of deviations. The control (audit) contour ensures risk identification, verification of information reliability, and formation of audit conclusions.

The integration of these components provides the possibility of transition to continuous auditing and increases the efficiency of response to deviations. The use of analytical tools makes it possible to identify anomalies, assess trends, and forecast possible deviations in enterprise activities.

A key factor in increasing the efficiency of the proposed model is the use of digital technologies. The application of Big Data analytics, artificial intelligence, and machine learning tools makes it possible to process significant volumes of financial and non-financial data, identify anomalies and hidden patterns, and forecast potential risks in production and export processes.

An important element of the model is product traceability technologies. They ensure control of product movement from production to the final consumer.

Within the framework of the model, it is substantiated that the risk-oriented approach is the basic instrument for increasing audit efficiency. Its application makes it possible to concentrate audit procedures on the most critical segments of activity, in particular transactions related to currency risks, logistics costs, export restrictions, and market price fluctuations.

Table 1. Risk system of production and export activities of agribusiness enterprises

		Business	risks		
*	Currency	Logistical	Regulatory	Production	Reputational
Source	Exchange rate	Transportation	Customs	Climate	Quality
Impact	Financial result	Cost	Reporting	Yield	Market
Level	High	High	Medium	High	Medium
Control	Hedging	Traceability	Compliance	Stat models	ESG

Source: developed by the author.

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Table 2. Conceptual model of accounting and analytical support for the audit of production and export of crop products

Model element	Content	Tools and technologies	Result for audit
Accounting component	Generation of primary information on production and export operations; reporting of biological assets and foreign trade transactions.	ERP systems; accounting systems, IFRS (IAS 41); automated accounting.	Completeness and reliability of accounting data.
Analytical component	Processing, systematization, and interpretation of data; identification of deviations and trends.	Big Data Analytics; economic analysis; BI systems; machine learning.	Detection of anomalies, risk forecasting.
Control (audit) component	Risk identification, verification of information reliability, formation of audit opinions.	Continuous Auditing, automated control, audit procedures.	Improved audit quality and reporting reliability.
Risk-oriented approach	Identification and prioritization of critical risks (currency, logistical, regulatory, market).	Risk analytics, ML models, scenario analysis.	Risk mitigation and increased audit efficiency.
Digital technologies	Integration of digital tools into all system elements.	AI, Big Data, ERP, automation, cloud technologies.	Accelerated data processing and increased accuracy.
Traceability	Monitoring product movement from production to export.	Blockchain (optional), GPS, logistics systems.	Increased transparency and verifiability of operations.
ESG Component	Integration of environmental and social indicators into the audit system.	ESG analytics, non-financial reporting.	Expansion of audit scope and enhanced investment attractiveness.

Source: developed by the author.

The implementation of the model contributes to improving the quality of audit evidence, reducing the duration of inspections, and increasing trust in the reporting of agribusiness enterprises. In addition, the integration of ESG indicators expands the possibilities for evaluating activities taking into account environmental and social aspects.

Particular attention is paid to the integration of sustainable development principles into the accounting and analytical support system. The inclusion of ESG indicators in the audit process makes it possible to carry out a comprehensive assessment of enterprise activities taking into account not only financial, but also environmental and social aspects, which is critically important under conditions of market globalization.

Thus, the proposed approach ensures the transition to an integrated system of accounting and analytical support for audit aimed at improving the efficiency of managing information flows in production and export activities. To formalize the proposed conceptual model of accounting and analytical support for the audit of production and export of crop products, it is advisable to present its structural elements in a generalized table (Table 2).

The presented model provides a comprehensive characterization of the interaction between accounting, analytical, and control processes within the audit system. Its application ensures a reduction in the risk of accounting information misstatement, enhances the efficiency of audit procedures, and improves the quality of management over the production and export activities of agribusiness enterprises.

Table 3. Comparison of the traditional and the proposed models of accounting and analytical support for audit

Criterion	Traditional Models	Proposed Model
System type	Fragmentary	Integrated digital system
Time horizon	Retrospective	Real-time
Audit function	Control and verification	Proactive analysis and forecasting
Data integration	Limited	Full (financial + non-financial)
Risk management	Reactive	Risk-oriented (preventive)
Technologies	Traditional IT	AI, Big Data, ML, ERP
Traceability	Partial or absent	Full (traceability, blockchain)
ESG component	Absent	Integrated
Auditor's role	Verifier / Controller	Analyst and risk manager
Outcome	Confirmation of reporting	Support for management decisions

Source: developed by the author.

Summarizing the research results, it is appropriate to emphasize the fundamental differences between the proposed model and existing approaches to accounting and analytical support for audit.

Thus, the proposed model possesses systemic advantages over traditional approaches and ensures a higher level of audit efficiency.

CONCLUSIONS

As a result of the conducted study, a holistic theoretical and methodological basis of accounting and analytical support for the audit of production and export of crop products was formed, which corresponds to the modern challenges of digital transformation and growing uncertainty of the external environment.

Unlike traditional approaches focused mainly on the retrospective reflection of business processes, the proposed approach ensures a transition to a proactive audit model within which the accounting and analytical system performs the functions not only of recording, but also of interpretation, forecasting, and prevention of risks. This fundamentally changes the role of audit-from an instrument of confirming reporting

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to a mechanism for supporting managerial decisions.

The key result of the study is the substantiation of an integrated digitally oriented system of accounting and analytical support that ensures synchronization of financial and non-financial data, increases the transparency of production and export processes, and creates conditions for continuous auditing. Practical implementation of such an approach makes it possible to significantly reduce information asymmetry, increase the reliability of accounting data, and shorten time lags in managerial decision-making.

The integration of digital technologies, in particular tools of Big Data analytics, artificial intelligence, and automated control, transforms the audit methodology by ensuring the transition to intellectualized procedures and increasing the accuracy of risk identification. This creates prerequisites for the formation of adaptive audit systems capable of responding to dynamic changes in the external environment.

It is important to substantiate the expediency of integrating product traceability technologies and ESG indicators into the accounting and analytical support system, which expands the boundaries of audit and makes it possible to carry out a comprehensive assessment of enterprise activities taking into account economic, environmental, and social aspects. This increases the investment attractiveness of agribusiness enterprises and their competitiveness in international markets.

Thus, audit in the agricultural sector should be based on the integration of digital technologies, analytical tools, and risk-oriented management. Its implementation ensures not only an increase in the quality of audit conclusions, but also the transformation of audit into a strategic instrument for managing business efficiency and sustainability.

Prospects for further research are related to the development of intellectualized accounting and analytical support systems capable of self-learning and adaptation, as well as to deepening the integration of cyber-physical technologies, sensor systems, and artificial intelligence algorithms into the processes of audit and management of agribusiness enterprises.

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