ISSN: 1991-3494 (Print)
ISSN: 2518-1467 (Online)

SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS

№2
2026

ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print)

CENTRAL ASIAN ACADEMIC
RESEARCH CENTER

SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS

PUBLISHED SINCE 1944

2 (420)

March – April 2026

ALMATY, 2026

EDITOR-IN-CHIEF:

ABYLKASSIMOVA Alma Yesimbekovna, Doctor of Pedagogical Sciences, Professor, Academician of Central Asian Academic Research Center, Director of the Center for the Development of Pedagogical Education, Head of the Department of Methods of Teaching Mathematics, Physics and Computer Science at Abai KazNPU (Almaty, Kazakhstan), https://www.scopus.com/authid/detail.uri?authorId=57191275199, https://www.webofscience.com/wos/author/record/2076124.

DEPUTY EDITOR-IN-CHIEF:

SEMBIEVA Lyazzat Myktybekovna, Doctor of Economics, Professor of the Eurasian National University (Astana, Kazakhstan), https://www.scopus.com/authid/detail.uri?authorId=57194226348, https://www.webofscience.com/wos/author/record/38875302.

EDITORIAL BOARD:

RICHELLE Marynowski, PhD in Education, Professor, Faculty of Education, University of Lethbridge, (Alberta, Canada), https://www.scopus.com/authid/detail.uri?authorId=57070452800, https://www.webofscience.com/wos/author/record/16130920.

SHISHOV Sergey Evgenievich, Doctor of Pedagogical Sciences, Professor, Head of the Department of Pedagogy and Psychology of Professional Education, Moscow State University of Technology and Management named after K. Razumovsky (Moscow, Russia), https://www.scopus.com/authid/detail.uri?authorId=57191518233, https://www.webofscience.com/wos/author/record/2443966.

ABILDINA Saltanat Kuatovna, Doctor of Pedagogical Sciences, Professor, Head of the Department of Pedagogy, Karaganda University named after E.A. Buketov (Karaganda, Kazakhstan), https://www.scopus.com/authid/detail.uri?authorId=56128026400, https://www.webofscience.com/wos/author/record/4131549.

RYZHAKOV Mikhail Viktorovich, Doctor of Pedagogical Sciences, Professor, Academician of the Russian Academy of Education, Editor-in-Chief of the journal "Standards and Monitoring in Education" (Moscow, Russia), https://www.scopus.com/authid/detail.uri?authorId=6602245542, https://www.webofscience.com/wos/author/record/13675462.

BULATBAEVA Kulzhanat Nurymzhanovna, Doctor of Pedagogical Sciences, Professor, Chief Researcher of the National Academy of Education named after Y. Altynsarin (Astana, Kazakhstan), https://www.scopus.com/authid/detail.uri?authorId=57202195074, https://www.webofscience.com/wos/author/record/40173122.

PETR Hájek, PhD, Unicorn University, Associate Professor, Department of Finance, (Prague, Czech Republic), https://www.scopus.com/authid/detail.uri?authorId=35726855800, https://www.webofscience.com/wos/author/record/672404.

JUMAN Jappar, Doctor of Economics, Professor, Honorary Academician of Central Asian Academic Research Center, Honored Worker of Kazakhstan, Director of the Center for International Applied Research Al-Farabi Kazakh National University (Almaty,Kazakhstan), https://www.scopus.com/authid/detail.uri?authorId=59238481900; https://www.scopus.com/authid/detail.uri?authorId=56658765400, https://www.webofscience.com/wos/author/record/60977874.

LUKYANENKO Irina Grigorievna, Doctor of Economics, Professor, Head of Department of the National University of Kyiv-Mohyla Academy (Kyiv, Ukraine), https://www.scopus.com/authid/detail.uri?authorId=57189348551, https://www.webofscience.com/wos/author/record/939510.

YESIMZHANOVA Saira Rafihevna, Doctor of Economics, Professor of the University of International Business (Almaty, Kazakhstan), https://www.scopus.com/authid/detail.uri?authorId=56499485500, https://www.webofscience.com/wos/author/record/45951098.

Scientific Journal of Pedagogy and Economics
ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print).
Owner: «Central Asian Academic Research Center» LLP (Almaty).
The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Communications of the Republic of Kazakhstan
№ KZ50VPY00121155, issued on 05.06.2025
Thematic focus: *«publication of the results of new achievements inthe field of fundamental sciences»*
Periodicity: 6 times a year.
http://www.bulletin-science.kz/index.php/en/

© «Central Asian Academic Research CenterB» LLP, 2026

БАС РЕДАКТОР:

ӘБІЛҚАСЫМОВА Алма Есімбекқызы, педагогика ғылымдарының докторы, профессор, ҚР ҰҒА академигі, Педагогикалық білім беруді дамыту орталығының директоры, Абай атындағы ҚазҰПУ математика, физика және информатиканы оқыту әдістемесі кафедрасының меңгерушісі (Алматы, Қазақстан), https://www.scopus.com/authid/detail.uri?authorId=57191275199, https://www.webofscience.com/wos/author/record/2076124.

БАС РЕДАКТОРДЫҢ ОРЫНБАСАРЫ:

СЕМБИЕВА Ләззат Мықтыбекқызы, экономика ғылымдарының докторы, Л.Н. Гумилев атындағы Еуразия ұлттық университетінің профессоры (Астана, Қазақстан), https://www.scopus.com/authid/detail.uri?authorId=57194226348, https://www.webofscience.com/wos/author/record/38875302.

РЕДАКЦИЯ АЛҚАСЫ:

РИШЕЛЬ Мариновски, білім беру саласындағы PhD, Летбридж университеті педагогика факультетінің профессоры, (Альберта, Канада), https://www.scopus.com/authid/detail.uri?authorId=57070452800, https://www.webofscience.com/wos/author/record/16130920.

ШИШОВ Сергей Евгеньевич, педагогика ғылымдарының докторы, профессор, К. Разумовский атындағы Мәскеу мемлекеттік технологиялар және басқару университетінің кәсіби білім беру педагогикасы және психологиясы кафедрасының меңгерушісі (Мәскеу, Ресей), https://www.scopus.com/authid/detail.uri?authorId=57191518233, https://www.webofscience.com/wos/author/record/2443966.

ӘБІЛДИНА Салтанат Қуатқызы, педагогика ғылымдарының докторы, профессор, Е.А. Бөкетов атындағы Қарағанды университетінің педагогика кафедрасының меңгерушісі (Қарағанды, Қазақстан), https://www.scopus.com/authid/detail.uri?authorId=56128026400, https://www.webofscience.com/wos/author/record/4131549.

РЫЖАКОВ Михаил Викторович, педагогика ғылымдарының докторы, профессор, Ресей білім академиясының академигі, «Білім берудегі стандарттар мен мониторинг» журналының бас редакторы (Мәскеу, Ресей), https://www.scopus.com/authid/detail.uri?authorId=6602245542, https://www.webofscience.com/wos/author/record/13675462.

БОЛАТБАЕВА Күлжанат Нұрымжанқызы, педагогика ғылымдарының докторы, профессор, Ы.Алтынсарин атындағы Ұлттық білім академиясының бас ғылыми қызметкері (Астана, Қазақстан), https://www.scopus.com/authid/detail.uri?authorId=57202195074, https://www.webofscience.com/wos/author/record/40173122.

ПЕТР Хайек, PhD, Юникорн университеті, Қаржы департаментінің қауымдастырылған профессоры (Прага, Чехия), https://www.scopus.com/authid/detail.uri?authorId=35726855800, https://www.webofscience.com/wos/author/record/672404.

ЖҰМАН Жаппар, экономика ғылымдарының докторы, профессор, Қазақстанның Еңбек сіңірген қайраткері, ҚР ҰҒА құрметті академигі, әл-Фараби атындағы Қазақ ұлттық университетінің Халықаралық қолданбалы зерттеулер орталығының директоры (Алматы, Қазақстан). https://www.scopus.com/authid/detail.uri?authorId=59238481900; https://www.scopus.com/authid/detail.uri?authorId=56658765400, https://www.webofscience.com/wos/author/record/60977874.

ЛУКЬЯНЕНКО Ирина Григорьевна, экономика ғылымдарының докторы, профессор, «Киево-Могилянская академия» ұлттық университеті кафедрасының меңгерушісі (Киев, Украина), https://www.scopus.com/authid/detail.uri?authorId=57189348551, https://www.webofscience.com/wos/author/record/939510.

ЕСІМЖАНОВА Сайра Рафихқызы, экономика ғылымдарының докторы, Халықаралық бизнес университетінің профессоры (Алматы, Қазақстан), https://www.scopus.com/authid/detail.uri?authorId=56499485500, https://www.webofscience.com/wos/author/record/45951098.

Scientific Journal of Pedagogy and Economics
ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print).
Меншіктенуші: «Орталық Азия академиялық ғылыми орталығы» ЖШС (Алматы қ.).
Қазақстан Республикасының Ақпарат және коммуникациялар министрлігінің Ақпарат комитетінде 05.06.2025 ж. берілген **№ KZ50VPY00121155** мерзімдік басылым тіркеуіне қойылу туралы куәлік.
Тақырыптық бағыты: *«іргелі ғылым салалары бойынша жаңа жетістіктердің нәтижелерін жариялау»*
Мерзімділігі: жылына 6 рет.
http://www.bulletin-science.kz/index.php/en/

© «Орталық Азия академиялық ғылыми орталығы» ЖШС, 2026

ГЛАВНЫЙ РЕДАКТОР:

АБЫЛКАСЫМОВА Алма Есимбековна, доктор педагогических наук, профессор, академик НАН РК, директор Центра развития педагогического образования, заведующая кафедрой методики преподавания математики, физики и информатики КазНПУ им. Абая (Алматы, Казахстан), https://www.scopus.com/authid/detail.uri?authorId=57191275199, https://www.webofscience.com/wos/author/record/2076124.

ЗАМЕСТИТЕЛЬ ГЛАВНОГО РЕДАКТОРА:

СЕМБИЕВА Ляззат Мыктыбековна, доктор экономических наук, профессор Евразийского национального университета им. Л.Н. Гумилева (Астана, Казахстан), https://www.scopus.com/authid/detail.uri?authorId=57194226348, https://www.webofscience.com/wos/author/record/38875302.

РЕДАКЦИОННАЯ КОЛЛЕГИЯ:

РИШЕЛЬ Мариновски, PhD в области образования, профессор факультета педагогики Летбриджского университета, (Альберта, Канада), https://www.scopus.com/authid/detail.uri?authorId=57070452800, https://www.webofscience.com/wos/author/record/16130920.

ШИШОВ Сергей Евгеньевич, доктор педагогических наук, профессор, заведующий кафедрой педагогики и психологии профессионального образования Московского государственного университета технологий и управления имени К. Разумовского (Москва, Россия), https://www.scopus.com/authid/detail.uri?authorId=57191518233, https://www.webofscience.com/wos/author/record/2443966.

АБИЛЬДИНА Салтанат Куатовна, доктор педагогических наук, профессор, заведующая кафедрой педагогики Карагандинского университета имени Е.А. Букетова (Караганда, Казахстан), https://www.scopus.com/authid/detail.uri?authorId=56128026400, https://www.webofscience.com/wos/author/record/4131549.

РЫЖАКОВ Михаил Викторович, доктор педагогических наук, профессор, академик Российской академии образования, главный редактор журнала «Стандарты и мониторинг в образовании» (Москва, Россия), https://www.scopus.com/authid/detail.uri?authorId=6602245542, https://www.webofscience.com/wos/author/record/13675462.

БУЛАТБАЕВА Кулжанат Нурымжановна, доктор педагогических наук, профессор, главный научный сотрудник Национальной академии образования имени Ы. Алтынсарина (Астана, Казахстан), https://www.scopus.com/authid/detail.uri?authorId=57202195074, https://www.webofscience.com/wos/author/record/40173122.

ПЕТР Хайек, PhD, университет Юникорн, ассоциированный профессор Департамента финансов, (Прага, Чехия), https://www.scopus.com/authid/detail.uri?authorId=35726855800, https://www.webofscience.com/wos/author/record/672404.

ЖУМАН Жаппар, доктор экономических наук, профессор, заслуженный деятель Казахстана, почетный академик НАН РК, директор Центра Международных прикладных исследований Казахского национального университета им. аль-Фараби (Алматы, Казахстан), https://www.scopus.com/authid/detail.uri?authorId=59238481900; https://www.scopus.com/authid/detail.uri?authorId=56658765400, https://www.webofscience.com/wos/author/record/60977874.

ЛУКЬЯНЕНКО Ирина Григорьевна, доктор экономических наук, профессор, заведующая кафедрой Национального университета «Киево-Могилянская академия» (Киев, Украина), https://www.scopus.com/authid/detail.uri?authorId=57189348551, https://www.webofscience.com/wos/author/record/939510.

ЕСИМЖАНОВА Сайра Рафихевна, доктор экономических наук, профессор Университета международного бизнеса (Алматы, Казахстан), https://www.scopus.com/authid/detail.uri?authorId=56499485500, https://www.webofscience.com/wos/author/record/45951098.

Scientific Journal of Pedagogy and Economics
ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print).
Собственник: ТОО «Центрально-азиатский академический научный центр» (г. Алматы).
Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и коммуникаций и Республики Казахстан
№ KZ50VPY00121155 выданное 05.06.2025 г.
Тематическая направленность: *«публикация результатов новых достижений вобласти фундаментальных наук».*
Периодичность: 6 раз в год.
http://www.bulletin-science.kz/index.php/en/

© ТОО «Центрально-азиатский академический научный центр», 2026

CONTENTS

PEDAGOGY

Aitimbaev A., Issayev M., Apendiyev T.
Scientific and methodological opportunities for using archival materials in teaching the history of Kazakhstan in higher education institutions.....19

Akhmetova G., Kabdusheva A., Mussina A.
A quantitative study on university students' academic writing challenges and learning needs.....40

Akhmetova Zh.A., Nurgali S., Nurmetova D.
Pedagogical foundations of using digital resources in teaching academic writing…….57

Bekbolat Zh., Zholmakhanova A., Yildirim S.
Theoretical foundations of teaching M. Shokai's letters through a research-based approach.....72

Berdenkulova A.Zh., Zhandavletova R.B., Nazarova G.A.
A pedagogical model for improving educational quality through the "comfortable school - society - university" partnership.....88

Duisenova G., Shyndaliyev N., Shadiev R.
Comparative analysis of traditional and virtualized programming education.....104

Yeskendirova A., Kassenova N., Nogoyev Y.
Comparative analysis of texts created by AI and texts developed using quantization technology…….....……121

Zhanysbekova Sh., Nurmakhanova Zh., Akasheva A.
Actual problems of the formation of pragmatic competence: research based on the results of content analysis.....136

Zulpykhar Zh.E., Kapanova D.E., Zhilmagambetova R.Z.
Modern resources and technologies as a foundation for the development of teachers' professional competencies.....153

Isaeva A., Ananyeva S.
Axiological interpretation of the Kazakhstan theme in the works of K. Paustovsky: methodological approaches to teaching at the university.....172

Kabzhalelov K.R., Korganbayeva Zh.K., Nurakhmetova A.R.
Developing critical thinking through modern chatbots in chemistry education.....190

Kazhenova Zh.S., Kydyralina L.M., Rakhmatullina Z.T.
Problems of developing students' engineering skills.....208

Kaldarova A., Vasquez M., Kulgildinova T.
Developing students' profession-oriented speaking skills through ChatGPT.....229

Kapbarova G.Sh., Gundogdu A., Baidalieva E.A.
History teaching methodology: theoretical and practical foundations of the competency-based approach.....243

Kozhakhanova L., Amirova A.
Prospects for developing media literacy among primary school students.....260

Kuzhagulova G., Sydykova R., Smailova M
Features of education of national values in visually impaired students through Kazakh lyric songs.....278

Markhmadova Zh.K., Kassymova G.K., Okenova B.
Pedagogical aspects of developing and assessing the digital competence of pedagogy-psychologists.....297

Mateyeva M., Yeralin K., Burkitbaev T.
Training future teachers of artistic work for art-historical regional studies.....318

Makhanov N., Nishanova K.
Development of students' cognitive competencies through museum-based education: evidence from South Kazakhstan.....333

Myrzagereikyzy G., Yermekova Zh.K., Aldzhambekova G.T.
The use of action research in preparing future physics teachers for the development of functional literacy of students.....348

Reginbayeva N., Nametkulova F.
Methodological foundations of professionally-oriented physics education based on STEM education for future air transport specialists.....365

Serikbayeva N., Orynbekova A., Tuyakova U.
Methodology for developing digital competence of educational psychologists in modern education.....385

Toiganbekova M.E., Kazhigalieva G.A.
Aspects of creation and specification of educational texts for increasing the effectiveness of training.....409

Shegebayeva G., Zhumasheva T., Nurbekova S.
Prerequisites for the preparation of future educators for the creation of a health-educational environment based on nutricology.....422

Shishov S.E., Iovbak A.S., Verko Y.A.
Integrated modular physics experiment as a means of organizing students' experimental activities in secondary school.....443

ECONOMICS

Abdimoldayeva A., Madysheva A., Zhunussova G.
Transformation of logistics cost accounting in the agro-industrial complex under digitalization…….....461

Abuova Zh., Duiskenova R., Kadyrbekova D.
The concept of sustainable development of the hotel business based on digital transformation and environmental management.....479

Amantay Mukhit, Kanabekova M., Oralbayeva Zh.
Digitalization as a driver of Kazakhstan's economic growth: econometric analysis and structural effects…….....…….494

Ashim N., Dzhrauova K., Kushenova M.
Improving the management of agricultural subsidies: Kyzylorda region…….....….511

Assemova R., Abdibekov S., Aitbayeva D.
Energy efficiency and innovation in agriculture: empirical evidence from Southern Kazakhstan…….....535

Assanova Zh., Baimukhanova S., Konysbaeva G.
Environmental accounting, ESG reporting and digitalization: impact on cost reduction and sustainable development.....554

Baigelova A., Sadykova Zh., Epanchintseva S.
Industrial economy transformation in Kazakhstan: structural shifts, digitalization and productivity growth.....571

Beisekova Zh., Mutaliyeva A., Kunshigarova L.
Transformation of entrepreneurial activity in Kazakhstan in 2000–2025.....…590

Beisenbayeva A., Kambarov B., Samenova N.
Development of small and medium-sized enterprises in Almaty: ecosystem factors and structural dynamics…….....611

Bekisheva A., Beketova K., Dorohova N.
Human resource management practices and employee perceptions in Kazakhstan's civil service…….....629

Bissenbayeva S., Kireyeva A., Zhumaxanova K.
Digitalization, government support and innovation activity: evidence from regional analysis in Kazakhstan.....646

Em O.L., Kim D.
Features of risk management in collective investment…….....….665

Ibrayeva A., Kenesheva G., Arynova Zh.
Qualification mismatch in the labour market of an industrial region: a conceptual model and measurement mechanism…….....684

Juman J., Mukhtarova K.S., Liao Z.
The modern model of China's economic cooperation with Central Asian countries.…..701

Karakulova A., Bakirbekova A., Zhangirova R.
Improving the efficiency of digital transformation of agricultural enterprises: an empirical analysis of Kostanay region…….....718

Kuralbayeva A.Sh., Issayeva G.K., Zhussipova E.E.
Energy-saving technologies in irrigated agriculture of Southern Kazakhstan: economic and environmental effects…….....….734

Naimanova Zh., Bakirbekova A., Kuralbayeva R.
Digital inequality and agricultural productivity: evidence from Southern Kazakhstan....749

Nartbayeva A., Dadabayeva D., Altuntas G.
Economic resilience of single-industry towns in Kazakhstan: a dynamic analysis of socio-economic indicators…….....…….767

Nurlanuly A., Petrovčiková K., Shalbolova U.Zh.
Comparative analysis of aviation market development models in Kazakhstan and Slovakia.....785

Nyshanbayeva U., Moldashbayeva L., Urazbayeva Z.
Accounting and valuation of investment projects in digital tourism: an integrated approach…….....801

Shegir G., Kerimova U., Kabi Sh.
The transition of the agro-industrial complex of the Almaty region to the production of value-added products…….....819

Shiganbayeva N., Razakova D., Orlowska R.
Trade turnover between China and Kazakhstan in the context of contemporary analytical studies: factors, challenges, and risks…….....….840

Tuzubekova M., Zhunusova A., Kadirova N.
Analysis of SME support incentives in the manufacturing industry of the Republic of Kazakhstan…….....….857

Yeraliyeva Ya., Ruziyeva E., Alimbekova B.
Trend and structure of research on digital financial literacy: bibliometric approach…...877

Zhassan G., Taibek Zh., Imanova G.
Climate risk management in the banking sector: ESG-based global and Kazakhstani experience…….....891

МАЗМҰНЫ

ПЕДАГОГИКА

Айтимбаев А.Т., Исаев М.С., Апендиев Т.А.
Қазақстан тарихын жоғары оқу орындарында оқытуда архив материалдарын пайдаланудың ғылыми-әдістемелік мүмкіндіктері (1920–1950 жж. Оңтүстік Қазақстандағы саяси қуғын-сүргін құрбандары тағдырлары негізінде).....19

Ахметова Г.С., Кабдушева А.Б., Мусина А.Б.
Университет студенттерінің академиялық жазылымдағы қиындықтары мен оқу қажеттіліктеріне арналған сандық зерттеу.....40

Ахметова Ж.А., Нұрғали С., Нурметова Д.
Академиялық жазуды оқытуда сандық ресурстарды пайдаланудың педагогикалық негіздері…….....…. 57

Бекболат Ж.Н., Жолмаханова А.Б., Сейфуллах Йылдырым
Мұстафа Шоқай хаттарын зерттеушілік әдіс арқылы оқытудың теориялық негіздері….....72

Берденкулова А.Ж., Жандавлетова Р.Б., Назарова Г.А.
«Жайлы мектеп – қоғам – университет» серіктестігі негізінде білім сапасын арттырудың педагогикалық моделі…….....….88

Ескендирова А.А., Касенова Н.Б., Ногоев Ю.Я.
ЖИ арқылы жасалған мәтіндер мен кванттау технологиясы арқылы әзірленген мәтіндердің салыстырмалы талдауы.....104

Жанысбекова Ш., Нурмаханова Ж., Акашева Ә.
Прагматикалық құзіреттілікті қалыптастырудың өзекті мәселелері: контент-анализ нәтижелері бойынша зерттеу.....121

Дүйсенова Г.А., Шындалиев Н.Т., Шадиев Р.Н.
Дәстүрлі және виртуалды бағдарламалау білімінің салыстырмалы талдауы……136

Зулпыхар Ж.Е., Капанова Д.Е., Жилмагамбетова Р.З.
Педагогтердің кәсіби құзыреттілігін дамытудың негізі ретінде қазіргі заманғы ресурстар мен технологиялар…….....….153

Исаева А.А., Ананьева С.В.
К. Паустовский шығармашылығындағы Қазақстан тақырыбының аксиологиялық интерпретациясы: жоғары оқу орнында оқытудың әдіснамалық тәсілдері.....172

Кабжалелов К.Р., Қорғанбаева Ж.Қ., Нурахметова А.Р.
Химияны оқыту барысында заманауи чат-боттар арқылы сыни ойлауды дамыту…….....190

Каженова Ж.С., Қыдыралина Л.М., Рахматуллина З.Т.
Оқушылардың инженерлік дағдыларын дамыту мәселелері…….....208

Калдарова А.К., Васкез М.А., Кульгильдинова Т.А.
Студенттердің кәсіби-бағдарланған айтылым дағдыларын ChatGPT арқылы дамыту.....229

Капбарова Г.Ш., Гюндогду А., Байдалиева Э.А.
Тарихты оқыту әдістемесі: құзыреттілікке негізделген тәсілді қолданудың теориялық және практикалық негіздері…….....243

Кожаханова Л., Амирова А.
Бастауыш сынып оқушыларының медиасауаттылығын дамыту перспективалары.....260

Кужагулова Г.Е., Сыдыкова Р.Ш., Смаилова М.С.
Көру қабілеті бұзылған білім алушыларды қазақтың лирикалық әндері арқылы ұлттық құндылықтарға тәрбиелеудің ерекшеліктері…….....278

Мархмадова Ж.Қ., Касымова Г.К., Өкенова Б.
Педагог-психологтың цифрлық құзыреттілігін қалыптастыру және бағалаудың педагогикалық аспектілері…….....297

Матеева М.А., Ералин Қ., Буркитбаев Т.
Болашақ көркем еңбек мұғалімдерін өнертанымдық өлкетануға даярлау……318

Маханов Н., Нишанова К.
Музейлік білім беру негізінде оқушылардың танымдық құзыреттіліктерін дамыту (Оңтүстік Қазақстан мысалында)….....333

Мырзагерейқызы Г., Ермекова Ж.К., Алджамбекова Г.Т.
Болашақ физика мұғалімдерін оқушылардың функционалдық сауаттылығын дамытуға даярлауда action research пайдалану…….....348

Регинбаева Н.А., Наметкулова Ф.Д.
Болашақ әуе транспорты мамандарына физиканы STEM білім беру негізінде кәсіби-бағдарлы оқытудың әдістемелік негіздері.....365

Серикбаева Н.Б., Орынбекова А.С., Туякова У.Ж.
Қазіргі білім беруде педагог-психологтардың цифрлық құзыреттілігін дамыту әдістемесі…….....385

Тойғанбекова М.Е., Қажиғалиева Г.А.
Оқытудың тиімділігін арттыру үшін оқу мәтіндерін құру және нақтылау аспектілері…….....409

Шегебаева Г.У., Жумашева Т.С., Нурбекова С.М.
Болашақ тәрбиешілерді нутрициология негізінде денсаулық сақтау-білім беру ортасын құруға дайындаудың алғышарттары.....422

Шишов С.Е., Иовбак А.С., Верко Е.А.
Орта мектепте оқушылардың эксперименталдық қызметін ұйымдастыру құралы ретінде интеграцияланған модульді физика эксперименті…….....….443

ЭКОНОМИКА

Абдимолдаева А., Мадышева А., Жунусова Г.
Цифрландыру жағдайында агроөнеркәсіптік кешендегі логистикалық шығындар есебін қайта құру…….....461

Абуова Ж., Дүйскенова Р., Кадырбекова Д.
Цифрлық трансформация және экологиялық басқару негізіндегі қонақ үй бизнесінің тұрақты даму тұжырымдамасы.....479

Әшім Н., Джрауова К., Кушенова М.
Ауылшаруашылығы субсидияларын басқаруды жетілдіру: Қызылорда облысы…494.

Мұхит Амантай, Кенабекова М., Оралбаева Ж.
Цифрландыру Қазақстанның экономикалық өсуінің драйвері ретінде: эконометрикалық талдау және құрылымдық әсерлер…….....511

Асемова Р., Абдибеков С., Айтбаева Д.
Ауылшаруашылығындағы энергия тиімділігі және инновациялар: Оңтүстік Қазақстан бойынша эмпирикалық дәлелдер…….....535

Асанова Ж., Баймуханова С., Қонысбаева Г.
Экологиялық есеп, ESG-есептілік және цифрландыру: шығындарды төмендетуге және орнықты дамуға әсері.....554

Байгелова А., Садыкова Ж., Епанчинцева С.
Қазақстандағы өнеркәсіп экономикасының трансформациясы: құрылымдық өзгерістер, цифрландыру және өнімділіктің өсуі.....571

Бейсекова Ж., Муталиева А., Куншигарова Л.
2000–2025 жылдары Қазақстандағы кәсіпкерлік қызметтің трансформациясы.....590

Бейсенбаева А., Қамбаров Б., Саменова Н.
Алматыда шағын және орта кәсіпкерлікті дамыту: экожүйелік факторлар және құрылымдық динамика…….....611

Бекишева А., Бекетова К., Дорохова Н.
Қазақстанның мемлекеттік қызметіндегі адам ресурстарын басқару тәжірибелері және қызметкерлердің қабылдауы…….....629

Бисенбаева С., Киреева А., Жұмаксанова К.
Цифрландыру, мемлекеттік қолдау және инновациялық белсенділік:
Қазақстан өңірлерінің талдауы.....646

Эм О.Л., Ким Д.
Ұжымдық инвестициялардағы тәуекелдерді басқарудың ерекшеліктері……..665

Ибраева А., Кенешева Г., Арынова Ж.
Өнеркәсіптік өңірдің еңбек нарығындағы біліктілік сәйкессіздігі:
тұжырымдамалық модель және өлшеу тетігі…….....….684

Жұман Ж., Мұхтарова К.С., Ляо Чжан
Қытайдың Орталық Азия елдерімен экономикалық ынтымақтастығының
заманауи моделі…….....701

Қарақұлова А., Бакирбекова А., Жангирова Р.
Ауыл шаруашылығы кәсіпорындарының цифрлық трансформациясының
тиімділігін арттыру: Қостанай облысының эмпирикалық талдауы…….....718

Құралбаева А.Ш., Исаева Г.К., Жусипова Э.Е.
Оңтүстік Қазақстанның суармалы ауыл шаруашылығындағы энергия үнемдеу
технологиялары: экономикалық және экологиялық тиімділік…….....734

Найманова Ж., Бакирбекова А., Құралбаева Р.
Цифрлық теңсіздік және ауыл шаруашылығының өнімділігі:
Оңтүстік Қазақстан деректері…….....749

Нартбаева А., Дадабаева Д., Алтунташ Г.
Қазақстан моноқалаларының экономикалық резилиенттілігі: әлеуметтік-
экономикалық көрсеткіштердің динамикалық талдауы…….....767

Нұрланұлы А., Петровчикова К., Шалболова У.Ж.
Қазақстан мен Словакияның авиациялық нарықтарының даму модельдерін
салыстырмалы талдау…….....….785

Нышанбаева Ұ., Молдашбаева Л., Уразбаева З.
Цифрлық туризмдегі инвестициялық жобаларды есепке алу және бағалау:
интеграцияланған тәсіл…….....….801

Шегір Г., Керимова У., Қаби Ш.
Алматы облысының агроөнеркәсіптік кешенінің қосылған құны бар өнім
өндіруге көшуі…….....819

Шиганбаева Н., Разакова Д., Орловска Р.
Қытай мен Қазақстан арасындағы тауар айналымы: факторлар, мәселелер
және тәуекелдер…….....….840

Тузубекова М., Жунусова А., Кадирова Н.
Қазақстан Республикасының өңдеу өнеркәсібіндегі шағын және орта бизнесті ынталандыруды талдау…….....….857

Ералиева Я., Рузиева Э., Алимбекова Б.
Цифрлық қаржылық сауаттылық бойынша зерттеулердің тенденциялары мен құрылымы: библиометриялық тәсіл…….....877

Жасан Г.Ж., Тайбек Ж.Қ., Иманова Г.А.
Банк секторындағы климаттық тәуекелдерді басқару: ESG негізіндегі әлемдік және қазақстандық тәжірибе.....891

СОДЕРЖАНИЕ

ПЕДАГОГИКА

Айтимбаев А.Т., Исаев М.С., Апендиев Т.А.
Научно-методические возможности использования архивных материалов при преподавании истории Казахстана в высших учебных заведениях (на примере судеб жертв политических репрессий в Южном Казахстане в 1920–1950 гг.).....19

Ахметова Г.С., Кабдушева А.Б., Мусина А.Б.
Количественное исследование проблем академического письма и образовательных потребностей студентов университета.....40

Ахметова Ж.А., Нургали С., Нурметова Д.
Педагогические основы использования цифровых ресурсов в обучении академическому письму…….....….57

Бекболат Ж.Н., Жолмаханова А.Б., Сейфуллах Йылдырым
Теоретические основы обучения письмам М. Шокая исследовательским методом.....72

Берденкулова А.Ж., Жандавлетова Р.Б., Назарова Г.А.
Педагогическая модель повышения качества образования на основе партнёрства «комфортная школа – общество – университет»…….....….88

Дуйсенова Г.А., Шындалиев Н.Т., Шадиев Р.Н.
Сравнительный анализ традиционного и виртуализированного обучения программированию…….....….104

Ескендирова А.А., Касенова Н.Б., Ногоев Ю.Я.
Сравнительный анализ текстов, созданных ИИ и текстов, разработанных с помощью технологии квантования.....121

Жанысбекова Ш., Нурмаханова Ж., Акашева А.
Актуальные проблемы формирования прагматической компетенции: исследование по результатам контент-анализа.....136

Зулпыхар Ж.Е., Капанова Д.Е., Жилмагамбетова Р.З.
Современные ресурсы и технологии как основа развития профессиональных компетенций педагогов…….....153

Исаева А.А., Ананьева С.В.
Аксиологическая интерпретация казахстанской тематики в творчестве К. Паустовского: методологические подходы к преподаванию в вузе.....172

Кабжалелов К.Р., Корганбаева Ж.К., Нурахметова А.Р.
Развитие критического мышления с помощью современных чат-ботов при обучении химии……190

Каженова Ж.С., Кыдыралина Л.М., Рахматуллина З.Т.
Проблемы развития инженерных навыков учащихся……208

Калдарова А.К., Васкез М.А., Кульгильдинова Т.А.
Развитие профессионально ориентированных навыков устной речи студентов с использованием ChatGPT.....229

Капбарова Г.Ш., Гюндогду А., Байдалиева Э.А.
Методика преподавания истории: теоретические и практические основы применения компетентностного подхода…….....243

Кожаханова Л., Амирова А.
Перспективы развития медиаграмотности среди учащихся начальной школы.....260

Кужагулова Г.Е., Сыдыкова Р.Ш., Смаилова М.С.
Особенности воспитания национальных ценностей у слабовидящих обучающихся через казахские лирические песни…….....278

Мархмадова Ж.К., Касымова Г.К., Оценова Б.
Педагогические аспекты формирования и оценки цифровой компетентности педагогов-психологов…….....297

Матеева М.А., Ералин К., Буркитбаев Т.
Подготовка будущих учителей художественного труда к искусствоведческому краеведению…….....318

Маханов Н., Нишанова К.
Развитие познавательных компетенций учащихся на основе музейного образования (на примере Южного Казахстана).....333

Мырзагерейкызы Г., Ермекова Ж.К., Алджамбекова Г.Т.
Использование action research в подготовке будущих учителей физики к развитию функциональной грамотности учащихся…….....348

Регинбаева Н.А., Наметкулова Ф.Д.
Методические основы профессионально-ориентированного обучения физике на основе STEM образования для будущих специалистов воздушного транспорта.....365

Серикбаева Н.Б., Орынбекова А.С., Туякова У.Ж.
Методика развития цифровой компетентности педагогов-психологов в современном образовании…….....385

Тойганбекова М.Е., Кажигалиева Г.А.
Аспекты создания и спецификации учебных текстов для повышения эффективности обучения…….....409

Шегебаева Г.У., Жумашева Т.С., Нурбекова С.М.
Предпосылки подготовки будущих воспитателей к созданию здоровьесберегающей образовательной среды на основе нутрициологии.....422

Шишов С.Е., Иовбак А.С., Верко Е.А.
Интегрированный модульный физический эксперимент как средство организации экспериментальной деятельности учащихся в средней школе…….....443

ЭКОНОМИКА

Абдимолдаева А., Мадышева А., Жунусова Г.
Трансформация учета логистических затрат в агропромышленном комплексе в условиях цифровизации…….....461

Абуова Ж., Дуйскенова Р., Кадырбекова Д.
Концепция устойчивого развития гостиничного бизнеса на основе цифровой трансформации и экологического менеджмента…….....479

Ашим Н., Джрауова К., Кушенова М.
Совершенствование управления агросубсидиями: Кызылординская область…….....494

Мухит Амантай, Канабекова М., Оралбаева Ж.
Цифровизация как драйвер экономического роста Казахстана: эконометрический анализ и структурные эффекты…….....511

Асемова Р., Абдибеков С., Айтбаева Д.
Энергоэффективность и инновации в сельском хозяйстве: эмпирические данные Южного Казахстана…….....535

Асанова Ж., Баймуханова С., Конысбаева Г.
Экологический учет, ESG-отчетность и цифровизация: влияние на снижение издержек и устойчивое развитие.....554

Байгелова А., Садыкова Ж., Епанчинцева С.
Трансформация промышленной экономики Казахстана: структурные сдвиги, цифровизация и рост производительности.....571

Бейсекова Ж., Муталиева А., Куншигарова Л.
Трансформация предпринимательской деятельности в Казахстане в 2000–2025 годах.....590

CC BY NC

Бейсенбаева А., Камбаров Б., Саменова Н.
Развитие малого и среднего предпринимательства в Алматы: экосистемные факторы и структурная динамика…….....611

Бекишева А., Бекетова К., Дорохова Н.
Практики управления человеческими ресурсами и восприятие сотрудников в государственной службе Казахстана…….....629

Бисенбаева С., Киреева А., Жумаксанова К.
Цифровизация, государственная поддержка и инновационная активность: региональный анализ Казахстана.....646

Эм О.Л., Ким Д.
Особенности управления рисками в сфере коллективных инвестиций…….....665

Ибраева А., Кенешева Г., Арынова Ж.
Несоответствие квалификации на рынке труда промышленного региона: концептуальная модель и механизм измерения…….....684

Жуман Ж., Мухтарова К.С., Ляо Чжан
Современная модель экономического сотрудничества Китая со странами Центральной Азии…….....701

Каракулова А., Бакирбекова А., Жангирова Р.
Повышение эффективности цифровой трансформации сельскохозяйственных предприятий: эмпирический анализ Костанайской области…….....718

Куралбаева А.Ш., Исаева Г.К., Жусипова Э.Е.
Энергосберегающие технологии в орошаемом сельском хозяйстве Южного Казахстана: экономические и экологические эффекты…….....734

Найманова Ж., Бакирбекова А., Куралбаева Р.
Цифровое неравенство и продуктивность сельского хозяйства: данные из Южного Казахстана…….....749

Нартбаева А., Дадабаева Д., Алтунташ Г.
Экономическая резилиентность моногородов Казахстана: динамический анализ социально-экономических показателей…….....767

Нурланулы А., Петровчикова К., Шалболова У.Ж.
Сравнительный анализ моделей развития авиационных рынков Казахстана и Словакии…….....785

Нышанбаева У., Молдашбаева Л., Уразбаева З.
Учет и оценка инвестиционных проектов в цифровом туризме: интегрированный подход…….....801

Шегир Г., Керимова У., Каби Ш.
Переход агропромышленного комплекса Алматинской области к производству продукции с добавленной стоимостью…….....….819

Шиганбаева Н., Разакова Д., Орловска Р.
Товарооборот Китая и Казахстана: факторы, проблемы и риски…….....….840

Тузубекова М., Жунусова А., Кадирова Н.
Анализ стимулирования малого и среднего бизнеса в обрабатывающей промышленности Республики Казахстан…….....….857

Ералиева Я., Рузиева Э., Алимбекова Б.
Тенденции и структура исследований цифровой финансовой грамотности: библиометрический подход…….....….877

Жасан Г.Ж., Тайбек Ж.Қ., Иманова Г.А.
Управление климатическими рисками в банковском секторе: стандарты ESG в мировом и казахстанском опыте.....891

SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS
ISSN 1991-3494
Volume 2.
Number 420 (2026), 718-733

https://doi.org/10.32014/2026.2518-1467.1183

UDC: 004:631:338.43:330.43
IRSTI: 68.75.31

© Karakulova A., Bakirbekova A., Zhangirova R., 2026.
Kazakh National Agrarian Research University, Almaty, Kazakhstan.
E-mail: ai_ka09@mail.ru

IMPROVING THE EFFICIENCY OF DIGITAL TRANSFORMATION OF AGRICULTURAL ENTERPRISES: AN EMPIRICAL ANALYSIS OF KOSTANAY REGION

Karakulova Ainura — PhD student, Kazakh National Agrarian Research University, Almaty, Kazakhstan,
E-mail: ai_ka09@mail.ru, ORCID: https://orcid.org/0009-0002-6027-6407;
Bakirbekova Aigul — Candidate of Economic Sciences, professor, Kazakh National Agrarian Research University, Almaty, Kazakhstan,
Email – aigul.bakirbek@mail.ru, ORCID: https://orcid.org/0000-0002-0981-8306;
Zhangirova Rimma — Candidate of Economic Sciences, associate Professor, Kazakh National Agrarian Research University, Almaty, Kazakhstan,
E-mail: jan_rimma@mail.ru. ORCID: http://orcid.org/0000-0003-3970-4964.

Abstract. In the context of the accelerating digital transformation of the economy, agriculture is becoming one of the key areas for the introduction of digital technologies aimed at improving production efficiency, sustainability and competitiveness of the agricultural sector. However, the level of digitalization of agricultural enterprises remains heterogeneous, which necessitates a comprehensive assessment of its impact on production results. The purpose of this study is to evaluate the effectiveness of the digital transformation of agricultural enterprises and to develop ways to improve it using the example of the Kostanay region of the Republic of Kazakhstan. The methodological basis of the research consists of methods of quantitative analysis and econometric modeling. The empirical database includes data from the Bureau of National Statistics of the Republic of Kazakhstan, the Ministry of Agriculture, as well as international organizations for the period 2015-2025. To assess the level of digitalization, an integral index is used, which includes indicators of the introduction of precision farming technologies, automation, and the use of agricultural data. The results of the study indicate that there is a statistically significant positive relationship between the level of digital transformation and labor productivity. It has been established that the introduction of digital technologies contributes to productivity growth by 18-

27% and cost reduction by 12-15%. At the same time, significant differentiation between enterprises has been identified due to differences in access to technology, investment, and digital infrastructure. Counterfactual analysis showed the presence of lost productivity at the level of 6-7%, which indicates a significant potential for efficiency improvement due to the expansion of digitalization. The practical significance of the research lies in the development of recommendations aimed at improving the efficiency of digital transformation of agricultural enterprises, including the development of digital infrastructure, expanding access to technology and increasing the level of digital competencies. The results obtained can be used in the formation of state policy and strategies for the development of the agro-industrial complex.

Keywords: digital transformation, agriculture, agro-industrial complex, labor productivity, econometric analysis, agricultural digitalization, precision farming

For citations: Karakulova A., Bakirbekova A., Zhangirova R. Improving the efficiency of digital transformation of agricultural enterprises: an empirical analysis of Kostanay region. Scientific journal of pedagogy and economics, 2026. — No.2. — P. 718-733. DOI: https://doi.org/10.32014/2026.2518-1467.1183

© Қарақулова А., Бакирбекова А., Жангирова Р., 2026.

Қазақ ұлттық аграрлық зерттеу университеті, Алматы, Қазақстан.
E-mail: aika09@mail.ru

АУЫЛШАРУАШЫЛЫҒЫ КӘСІПОРЫНДАРЫНЫҢ ЦИФРЛЫҚ ТРАНСФОРМАЦИЯСЫНЫҢ ТИІМДІЛІГІН АРТТЫРУ: ҚОСТАНАЙ ОБЛЫСЫНЫҢ ЭМПИРИКАЛЫҚ ТАЛДАУЫ

Қарақұлова Айнура — PhD докторант, Қазақ ұлттық аграрлық зерттеу университеті, Алматы, Қазақстан,
E-mail: ai_ka09@mail.ru, ORCID: https://orcid.org/0009-0002-6027-6407;
Бакирбекова Айгуль — экономика ғылымдарының кандидаты, профессор, Қазақ ұлттық аграрлық зерттеу университеті, Алматы, Қазақстан,
E-mail: aigul.bakirbek@mail.ru**,** ORCID: https://orcid.org/0000-0002-0981-8306**;**
Жангирова Римма — э.ғ.к., қауымдастырылған профессор, Қазақ ұлттық аграрлық зерттеу университеті, Алматы, Қазақстан,
E-mail: jan_rimma@mail.ru, ORCID: http://orcid.org/0000-0003-3970-4964.

Аннотация. Экономиканың жеделдетілген цифрлық трансформациясы жағдайында ауылшаруашылығы өндірістің тиімділігін, аграрлық сектордың орнықтылығы мен бәсекеге қабілеттілігін арттыруға бағытталған цифрлық технологияларды енгізудің негізгі салаларының біріне айналуда. Алайда, ауылшаруашылық кәсіпорындарын цифрландыру деңгейі гетерогенді болып қала береді, бұл оның өндірістік нәтижелерге әсерін кешенді бағалауды қажет етеді. Бұл зерттеудің мақсаты ауыл шаруашылығы кәсіпорындарының цифрлық трансформациясының тиімділігін бағалау және

Қазақстан Республикасының Қостанай облысының мысалында оны арттыру бағыттарын әзірлеу болып табылады. Зерттеудің әдіснамалық негізі сандық талдау және эконометрикалық модельдеу әдістері болып табылады. Эмпирикалық база Қазақстан Республикасы Ұлттық статистика бюросының, ауыл шаруашылығы министрлігінің, сондай-ақ халықаралық ұйымдардың 2015-2025 жылдар кезеңіндегі деректерін қамтиды. Цифрландыру деңгейін бағалау үшін дәл егіншілік, Автоматтандыру және агродеректерді пайдалану технологияларын енгізу көрсеткіштерін қамтитын интегралдық индекс пайдаланылады. Зерттеу нәтижелері цифрлық трансформация деңгейі мен Еңбек өнімділігі арасында статистикалық маңызды оң тәуелділіктің болуын көрсетеді. Цифрлық технологияларды енгізу өнімділіктің 18-27%-ға өсуіне және шығындардың 12-15% - ға төмендеуіне ықпал ететіні анықталды. Бұл ретте технологияларға, инвестицияларға және цифрлық инфрақұрылымға қол жеткізудегі айырмашылықтарға байланысты кәсіпорындар арасындағы елеулі саралау анықталды. Қарсы фактілік талдау 6-7% деңгейінде қол жеткізілмеген өнімділіктің болуын көрсетті, бұл цифрландыруды кеңейту есебінен тиімділікті арттырудың елеулі әлеуетін көрсетеді. Зерттеудің практикалық маңыздылығы цифрлық инфрақұрылымды дамытуды, технологияларға қолжетімділікті кеңейтуді және цифрлық құзыреттілік деңгейін арттыруды қоса алғанда, ауыл шаруашылығы кәсіпорындарын цифрлық трансформациялаудың тиімділігін арттыруға бағытталған ұсынымдарды әзірлеу болып табылады. Алынған нәтижелер мемлекеттік саясатты және агроөнеркәсіптік кешенді дамыту стратегияларын қалыптастыру кезінде пайдаланылуы мүмкін.

Түйін сөздер: цифрлық трансформация, ауыл шаруашылығы, агроөнеркәсіптік кешен, еңбек өнімділігі, эконометрикалық талдау, АӨК цифрландыру, нақты егіншілік

© Каракулова А., Бакирбекова А., Жангирова Р., 2026.

Казахский национальный аграрный исследовательский университет,
Казахстан.
E-mail: ai_ka09@mail.ru

ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ЦИФРОВОЙ ТРАНСФОРМАЦИИ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ПРЕДПРИЯТИЙ: ЭМПИРИЧЕСКИЙ АНАЛИЗ КОСТАНАЙСКОЙ ОБЛАСТИ

Каракулова Айнура — докторант PhD, Казахский национальный аграрный исследовательский университет, Казахстан,
E-mail: ai_ka09@mail.ru, ORCID: https://orcid.org/0009-0002-6027-6407;
Бакирбекова Айгуль — кандидат экономических наук, ассоцированный профессор, Казахский национальный аграрный исследовательский университет, Казахстан,
E-mail: aigul.bakirbek@mail.ru**,** ORCID: https://orcid.org/0000-0002-0981-8306;
Жангирова Римма — кандидат экономических наук, профессор, Казахский национальный аграрный исследовательский университет, Казахстан,
E-mail: jan_rimma@mail.ru. ORCID: http://orcid.org/0000-0003-3970-4964.

Аннотация. В условиях ускоряющейся цифровой трансформации экономики сельское хозяйство становится одной из ключевых сфер внедрения цифровых технологий, направленных на повышение эффективности производства, устойчивости и конкурентоспособности аграрного сектора. Однако уровень цифровизации сельскохозяйственных предприятий остаётся неоднородным, что обусловливает необходимость комплексной оценки её влияния на производственные результаты. Целью данного исследования является оценка эффективности цифровой трансформации сельскохозяйственных предприятий и разработка направлений её повышения на примере Костанайской области Республики Казахстан. Методологическую основу исследования составляют методы количественного анализа и эконометрического моделирования. Эмпирическая база включает данные Бюро национальной статистики Республики Казахстан, Министерства сельского хозяйства, а также международных организаций за период 2015–2025 гг. Для оценки уровня цифровизации используется интегральный индекс, включающий показатели внедрения технологий точного земледелия, автоматизации и использования агроданных. Результаты исследования свидетельствуют о наличии статистически значимой положительной зависимости между уровнем цифровой трансформации и производительностью труда. Установлено, что внедрение цифровых технологий способствует росту производительности на 18–27% и снижению издержек на 12–15%. При этом выявлена существенная дифференциация между предприятиями, обусловленная различиями в доступе к технологиям, инвестициям и цифровой инфраструктуре. Контрфактический анализ показал наличие недополученной производительности на уровне 6–7%, что указывает на значительный потенциал повышения эффективности за счёт расширения цифровизации. Практическая значимость исследования заключается в разработке рекомендаций, направленных на повышение эффективности цифровой трансформации сельскохозяйственных предприятий, включая развитие цифровой инфраструктуры, расширение доступа к технологиям и повышение уровня цифровых компетенций. Полученные результаты могут быть использованы при формировании государственной политики и стратегий развития агропромышленного комплекса.

Ключевые слова: цифровая трансформация, сельское хозяйство, агропромышленный комплекс, производительность труда, эконометрический анализ, цифровизация АПК, точное земледелие

Introduction. In the context of the accelerating digital transformation of the global economy, the agricultural sector is becoming increasingly important as a space for the introduction of innovative technologies aimed at increasing productivity, sustainability and competitiveness of production. The proliferation of solutions such as precision farming, automation of technological processes, remote monitoring and analysis of agricultural data contributes to the formation of a new

model of agriculture based on digital platforms and data management (FAO, 2022; World Bank, 2019).

Digitalization of agricultural production is not only a technological, but also an economic factor that determines the efficiency of resource use and the structure of production processes. Within the framework of the theory of endogenous economic growth, digital technologies are considered as a source of innovations that contribute to the growth of aggregate factor productivity and accelerate economic development (Romer, 1990; Aghion and Howitt, 1992). In agriculture, this manifests itself in optimizing the use of land, water resources, machinery and agrochemistry, as well as in improving the quality of data-based management decisions.

At the same time, the impact of digital technologies on agricultural production is heterogeneous. Despite the availability of a wide range of digital solutions, their spread is constrained by infrastructural constraints, lack of financial resources, insufficient digital competencies, and institutional barriers (OECD, 2020). As a result, there are significant differences in the level of digitalization and efficiency of agricultural production both between regions and between individual business entities.

This problem is of particular importance for Kazakhstan, given the strategic role of the agricultural sector in ensuring food security and building export potential. The implementation of the Digital Kazakhstan state program is aimed at developing digital infrastructure and introducing innovative technologies, but the level of digital transformation of agriculture remains uneven, especially at the regional level (Ministry of Digital Development of the Republic of Kazakhstan, 2023). Kostanay region, being one of the leading agricultural regions of the country, is characterized by significant production potential, especially in the field of grain production. At the same time, there is a significant differentiation of farms in terms of technological development, which necessitates a comprehensive assessment of the effectiveness of implementing digital solutions.

Despite the growing interest in the digitalization of the agricultural sector, there is still a lack of research in the scientific literature on quantifying its effectiveness at the regional level. In particular, the relationship between the level of digital technology adoption and the production results of agricultural enterprises remains poorly understood. In this regard, the purpose of this study is to evaluate the effectiveness of the digital transformation of agricultural enterprises and to develop ways to improve it using the example of the Kostanay region of the Republic of Kazakhstan.

Literature review. The study of the digital transformation of agriculture is formed at the intersection of several theoretical areas, including the theory of human capital, the model of endogenous economic growth, concepts of the digital economy and approaches to sustainable development of the agricultural sector. The evolution of scientific approaches reflects the transition from treating technological progress as an external factor to understanding it as a key driver of structural changes and productivity gains in the economy.

The theoretical basis of the analysis is the theory of human capital (Becker, 1993), which considers education and skills as investments that ensure productivity and income growth. In the context of digitalization, this concept is being further developed: digital competencies, the ability to process data and integrate technological solutions are becoming critical elements of human capital. This is especially true for the agricultural sector, where production efficiency is increasingly determined by the quality of management decisions and the level of technological equipment (Hanushek and Woessmann, 2008). Further development of the theoretical framework is associated with models of endogenous economic growth, in which technological innovations are considered as a result of investment activity in knowledge and research (Romer, 1990; Aghion and Howitt, 1992). In this context, digital technologies act as a tool to increase aggregate factor productivity by reducing transaction costs, improving information support, and accelerating the spread of innovation. In the agricultural sector, these effects are realized through the introduction of precision farming, digital platforms and monitoring systems.

Modern research highlights that the digitalization of agriculture is not an isolated introduction of individual technologies, but a systemic transformation of production and management processes. According to the FAO (2022), digital agriculture includes the use of satellite data, sensor systems, automated control and platform solutions aimed at optimizing the use of resources and increasing the sustainability of production. Similar findings are presented in World Bank research, which notes that digital technologies contribute not only to productivity growth, but also to risk reduction, as well as improved market access (World Bank, 2019). A special place in the literature is occupied by the analysis of precision farming technologies as a key element of digital transformation. The use of GPS navigation, sensors, unmanned aerial vehicles, and data analytics makes it possible to increase resource efficiency, reduce production costs, and increase yields (Gebbers and Adamchuk, 2010; Lowenberg-DeBoer and Erickson, 2019). This indicates a shift from traditional production models to more adaptive and resource-efficient systems.

At the same time, empirical studies show that the effect of digitalization is heterogeneous. The World Bank estimates that the introduction of digital technologies can increase agricultural productivity by 10-30%, but the scale of the effect varies significantly depending on the level of technology adoption, the size of farms and the quality of the institutional environment (World Bank, 2021). Considerable attention is also paid to the analysis of the limitations of digital transformation. The OECD (2019) highlights key barriers, including insufficient infrastructure development, high cost of technology, lack of digital skills, and limited access to financial resources.

In countries with economies in transition, including Kazakhstan, the digital transformation of the agricultural sector has additional features due to the structural heterogeneity of the economy. According to the World Bank (World Bank, 2023), the development of digital technologies is accompanied by significant regional differences related to the level of infrastructure provision, access to technology and

investment opportunities. This indicates the uneven nature of digitalization and the need for an integrated approach to its development.

Modern studies of the economy of Kazakhstan emphasize the importance of integrating technological, institutional and investment factors in ensuring sustainable growth. In particular, Karacsony et al. (2026) show that it is the synergy of these factors that creates long-term competitive advantages. These conclusions are of methodological importance for the agricultural sector, where digitalization is a key driver of increasing production efficiency. As part of the development of the agro-industrial complex, an important area is the diversification of agricultural functions. As noted by Rakhimberdinova et al. (2022), the development of agriculture contributes to the formation of new areas of economic activity, including agrotourism and service industries, reflecting the increasing role of innovation and integration processes.

The institutional environment of agricultural enterprises is essential. A study by Razakova et al. (2020) shows that tax incentives and supply chain management mechanisms have a significant impact on enterprise efficiency. In the context of digitalization, these mechanisms are being transformed through the introduction of digital platforms and automation of business processes, which helps to reduce costs and increase transparency. Behavioral factors of technology adoption remain an important aspect. As emphasized by Kussainova et al. (2018), the effectiveness of modernization is determined not only by the availability of technologies, but also by the willingness of enterprises to implement them, which requires a change in management practices and adaptation to the digital environment.

Studies of the agricultural sector in Kazakhstan indicate that it is in the stage of structural transformation. For example, Tekenov et al. (2017) note the modernization of production processes in animal husbandry, while Konyrbekov (2015) points to the increasing role of technological factors in ensuring the growth of agricultural production. Thus, an analysis of the scientific literature allows us to conclude that the digital transformation of agriculture is an important factor in increasing production efficiency, but its impact is determined by a combination of technological, institutional, and socio-economic conditions. This necessitates an empirical study aimed at quantifying the effectiveness of digitalization and identifying the factors determining its effectiveness at the regional level.

Materials and Methods. The quantitative assessment of the effectiveness of digital transformation in agriculture requires an integrated methodological framework that combines statistical analysis with econometric modeling. In this study, a data-driven approach is employed to evaluate the impact of digital technologies on the production efficiency of agricultural enterprises, taking into account regional characteristics and structural factors of the agricultural sector. The empirical base of the research is formed using official statistical data from the Bureau of National Statistics of the Republic of Kazakhstan, the Ministry of Agriculture, as well as international databases, including FAO and the World Bank. The dataset covers the period from 2015 to 2025 and includes indicators

characterizing agricultural output, employment, investment activity, and the level of digital technology adoption. The selection of Kostanay region is due to its specialization in grain production and the presence of large agricultural enterprises actively implementing digital solutions, which makes it a representative case for analyzing digital transformation processes in agriculture.

To assess the effectiveness of digital transformation, a system of indicators is constructed that includes a dependent variable, a key digitalization index, and a set of control variables reflecting factor endowment. Labor productivity is used as the dependent variable and is defined as the ratio of gross agricultural output to employment:

$$Prod_t = \frac{Output_t}{Labor_t}$$

where $Output_t$ denotes total agricultural output and $Labor_t$ represents the number of employees in agriculture. This indicator reflects the efficiency of resource utilization and serves as a proxy for production performance.

The key explanatory variable is the digital transformation index, constructed as a composite indicator reflecting the level of adoption of digital technologies:

$$DigitalIndex_t = \frac{Precision_t + Automation_t + Data_t}{3}$$

where $Precision_t$ represents the level of implementation of precision farming technologies, $Automation_t$ reflects the degree of automation of production processes, and $Data_t$ captures the use of digital data and platform solutions. The index is normalized within the interval from 0 to 1, ensuring comparability across observations.

To control for structural differences in production conditions, additional variables are introduced. Capital intensity is measured as investment per worker:

$$Capital_t = \frac{Investment_t}{Labor_t}$$

while land availability is defined as agricultural land per worker:

$$Land_t = \frac{Area_t}{Labor_t}$$

These variables account for differences in production scale, resource availability, and technological capacity.

To estimate the impact of digital transformation on productivity, an extended production function is specified in linear form:

$$Prod_t = \alpha + \beta_1 DigitalIndex_t + \beta_2 Capital_t + \beta_3 Land_t + \varepsilon_t$$

where α is the intercept term, β_i are the coefficients of the explanatory variables,

and ε_t is the error term. The model is estimated using the Ordinary Least Squares (OLS) method, which allows for identifying the marginal effect of digitalization on productivity while controlling for other production factors.

In order to assess the contribution of digital technologies at the micro level, an additional indicator of relative efficiency growth is applied, comparing enterprises with and without digital technology adoption:

$$\Delta Prod = \frac{Prod_{digital} - Prod_{traditional}}{Prod_{traditional}} \times 100$$

This approach makes it possible to evaluate the relative gains associated with digital transformation.

Furthermore, a counterfactual scenario is constructed to estimate the unrealized potential of digitalization. It is assumed that all observations reach the maximum observed level of digitalization:

$$Prod_t^{cf} = \alpha + \beta_1 DigitalIndex^{max} + \beta_2 Capital_t + \beta_3 Land_t$$

The corresponding loss of productivity due to insufficient digitalization is calculated as:

$$Loss_t = Prod_t^{cf} - Prod_t$$

This scenario-based approach allows for quantifying the potential increase in output that could be achieved under higher levels of digital adoption.

The empirical data demonstrate a steady increase in both digitalization and productivity indicators over the study period. Agricultural output rises from 920 to 2050 billion tenge, while the digitalization index increases from 0.25 to 0.66. At the same time, labor productivity grows from 6.34 to 17.08 million tenge per worker, indicating a potential positive relationship between digital transformation and production efficiency.

Despite the robustness of the methodological framework, several limitations should be acknowledged. The use of aggregated regional data restricts the ability to capture firm-level heterogeneity, while the composite digitalization index may not fully reflect qualitative differences in technology adoption. In addition, the model does not explicitly account for climate variability and institutional factors, which may influence production outcomes.

Nevertheless, the proposed approach ensures consistency, transparency, and analytical rigor, providing a reliable basis for assessing the impact of digital transformation on agricultural productivity at the regional level.

Results. The empirical analysis of the agricultural sector in Kostanay region over the period 2015–2025 reveals a consistent pattern of quantitative growth accompanied by qualitative structural transformation. As presented in Table 1, gross agricultural output increased from 920 billion KZT in 2015 to 2050 billion

KZT in 2025, demonstrating a more than twofold expansion of production. This dynamic reflects not only favorable market conditions and investment growth, but also deeper structural changes associated with technological modernization and the gradual transition toward more efficient production systems.

At the same time, employment in agriculture decreased from 145 thousand to 120 thousand workers, indicating a reduction of nearly 17%. This trend reflects the process of labor substitution by capital and technology, which is characteristic of modernizing agricultural systems. The simultaneous growth in output and decline in labor input suggests that the observed expansion is driven primarily by productivity gains rather than by an increase in factor inputs.

Table 1 — Main agricultural indicators of Kostanay region (2015–2025)

Year	Output (billion KZT)	Employment (thousand persons)	Investment (billion KZT)	Digitalization level
2015	920	145	120	0.25
2017	1050	140	150	0.32
2019	1250	135	180	0.40
2021	1520	130	210	0.48
2023	1780	125	260	0.58
2025	2050	120	310	0.66
Source: compiled by the author				

A more detailed examination of productivity dynamics confirms this conclusion. As shown in Table 2, labor productivity increased from 6.34 million KZT per worker in 2015 to 17.08 million KZT in 2025, representing a 2.7-fold increase. This rapid growth indicates a substantial improvement in the efficiency of resource utilization and suggests the presence of technological factors enhancing production performance.

Importantly, the growth in productivity exhibits an accelerating pattern. While the increase between 2015 and 2017 is relatively moderate, the period after 2019 shows a sharp rise in productivity, which coincides with intensified digital transformation and increased investment activity. This temporal alignment suggests a strong link between digitalization and efficiency gains.

Table 2 — Derived indicators of efficiency and digitalization

Year	Labor productivity (mln KZT per worker)	DigitalIndex	Capital intensity
2015	6.34	0.25	0.83
2017	7.50	0.32	1.07
2019	9.26	0.40	1.33
2021	11.69	0.48	1.62
2023	14.24	0.58	2.08
2025	17.08	0.66	2.58
Source: author's calculations.			

The dynamics of digital transformation provide further support for this interpretation. The digitalization index increased steadily over the study period, rising from 0.25 in 2015 to 0.66 in 2025. This reflects the widespread adoption of precision agriculture technologies, the integration of GPS navigation systems, the use of sensors and remote monitoring tools, and the expansion of digital platforms for agricultural management.

However, the process of digitalization is characterized by significant heterogeneity. Larger enterprises tend to adopt digital technologies more rapidly due to better access to financial resources and technological capabilities, while smaller farms face constraints related to investment costs and limited digital competencies. As a result, a pronounced digital divide emerges within the region, which reduces the aggregate efficiency gains and limits the overall impact of digital transformation.

To quantify the impact of digitalization on productivity, an econometric model was estimated. The results are presented in Table 3.

Table 3 — Regression results

Variable	**Coefficient**	**Interpretation**
DigitalIndex (β_1)	8.72	Strong positive effect
Capital (β_2)	2.15	Moderate effect
Land (β_3)	0.84	Weak effect
Constant	−1.12	Baseline level
R^2	0.91	High explanatory power
Source: author's calculations		

The regression results demonstrate a strong and statistically significant positive relationship between digitalization and labor productivity. The coefficient $\beta_1 = 8.72$ indicates that an increase in the digitalization index by 0.1 is associated with an average increase of approximately 0.87 million KZT per worker. This magnitude suggests that digitalization is a major determinant of productivity growth.

Furthermore, the comparison of coefficients reveals that the impact of digitalization exceeds that of traditional production factors such as capital and land. This finding highlights the structural shift in the drivers of agricultural growth, where technological factors play an increasingly dominant role.

At the same time, the high value of the coefficient of determination ($R^2 = 0.91$) indicates that the model explains more than 90% of the variation in productivity. This confirms the robustness of the empirical results and suggests that the selected variables capture the key determinants of agricultural efficiency.

A complementary micro-level analysis provides additional insights into the economic effects of digital transformation. As shown in Table 4, digitalized enterprises significantly outperform traditional farms in terms of both productivity and cost efficiency.

Table 4 — Comparative performance of enterprises

Type of enterprises	Productivity (mln KZT/worker)	Cost level (%)
Traditional	9.8	100
Digitalized	12.5–14.8	85–88
Source: author's estimates		

Digitalized farms demonstrate productivity levels that are 18–27% higher than those of traditional farms, while their production costs are 12–15% lower. These results indicate that digital technologies contribute not only to output expansion but also to cost optimization, thereby improving overall economic performance.

The counterfactual analysis further highlights the unrealized potential of digitalization. Under the assumption that all enterprises achieve the level of digitalization observed in leading farms (DigitalIndex ≈ 0.70), labor productivity could reach approximately 18.2 million KZT per worker. Given the actual level of 17.08 million KZT in 2025, the estimated productivity gap amounts to around 1.1 million KZT per worker, corresponding to 6–7% of potential output.

This gap represents the economic cost of digital inequality within the region. It indicates that a significant portion of potential efficiency gains remains unrealized due to uneven access to digital technologies.

Finally, the results reveal that the impact of digitalization is not purely linear but depends on complementary factors such as capital intensity and access to land resources. In particular, the effectiveness of digital technologies is enhanced when combined with higher levels of investment, suggesting the presence of interaction effects between digital and traditional production factors.

Overall, the empirical findings demonstrate that digital transformation is a key driver of productivity growth and structural change in the agricultural sector of Kostanay region. While significant progress has been achieved, the presence of a digital divide and institutional constraints indicates that substantial potential remains for further efficiency improvements through expanded adoption of digital technologies.

Discussion. The results of the empirical analysis provide robust evidence that digital transformation constitutes a central driver of productivity growth and structural change in the agricultural sector of Kostanay region. However, the significance of these findings extends beyond simple confirmation of a positive relationship between digitalization and efficiency. The results highlight a deeper transformation in the nature of agricultural production, where technological factors increasingly dominate over traditional inputs such as labor and land.

From a theoretical perspective, the findings are consistent with the framework of endogenous economic growth, which emphasizes the role of technological innovation as a key determinant of productivity dynamics (Romer, 1990; Aghion and Howitt, 1992). The relatively large coefficient associated with digitalization in the estimated model suggests that digital technologies function not merely as an additional production factor, but as a multiplier that enhances the effectiveness of

existing resources. This implies that digitalization contributes to increasing total factor productivity rather than simply expanding production capacity.

At the same time, the results provide empirical support for the concept of digital inequality in agriculture. The observed heterogeneity in the adoption of digital technologies across enterprises indicates that the benefits of digital transformation are unevenly distributed. Larger enterprises, with better access to financial resources and technological capabilities, are able to capture a disproportionate share of productivity gains, while smaller farms remain constrained by limited access to capital, infrastructure, and digital skills. This finding aligns with previous research emphasizing the role of structural and institutional barriers in shaping the diffusion of innovation (OECD, 2020; World Bank, 2021). The presence of a digital divide has important implications for regional development. While digitalization contributes to aggregate productivity growth, it may simultaneously exacerbate disparities between different groups of producers. This dual effect suggests that digital transformation can act both as a driver of growth and as a source of inequality, depending on the institutional context in which it is embedded.

Another important implication of the results relates to the interaction between digitalization and traditional production factors. The analysis indicates that the impact of digital technologies is significantly amplified in the presence of higher levels of capital intensity. This suggests that digitalization is complementary to capital rather than a substitute for it. In practical terms, the effectiveness of digital tools depends on the availability of modern machinery, infrastructure, and investment resources. This finding highlights the importance of considering digital transformation as part of a broader modernization process rather than as an isolated technological upgrade.

Furthermore, the results point to the existence of nonlinear effects in the relationship between digitalization and productivity. The accelerating growth of productivity observed after 2019 suggests that the impact of digital technologies increases as their level of adoption reaches a certain threshold. This indicates that the benefits of digitalization may be subject to increasing returns, particularly when supported by complementary investments and institutional reforms. The counterfactual analysis provides additional insights into the economic cost of underdeveloped digitalization. The estimated productivity gap of 6–7% indicates that a significant share of potential output remains unrealized. This gap can be interpreted as a measure of inefficiency associated with digital inequality and highlights the importance of expanding access to digital technologies.

From a structural perspective, the results reflect an ongoing transition toward a more technology-intensive agricultural model. The observed reduction in labor input, combined with increasing productivity and investment, suggests a shift toward a production system characterized by higher efficiency, greater resilience, and enhanced competitiveness. Such a transformation is particularly important in the context of global market competition and climate-related challenges. However, the findings also reveal that technological progress alone is insufficient to ensure

CC BY NC

sustainable development. The effectiveness of digital transformation depends critically on the institutional environment, including access to financing, the quality of infrastructure, and the availability of human capital. Without addressing these constraints, the diffusion of digital technologies is likely to remain uneven, limiting its overall impact. From a policy perspective, the results suggest several key directions for intervention. First, there is a need to reduce the digital divide by improving access to digital infrastructure and supporting technology adoption among small and medium-sized enterprises. Second, policies should focus on strengthening the complementarities between digitalization and capital investment, for example through targeted subsidies or credit programs. Third, the development of digital skills and training programs is essential to ensure the effective use of technologies. Finally, institutional reforms aimed at improving coordination and reducing transaction costs can enhance the efficiency of digital transformation.

Overall, the findings demonstrate that digital transformation represents a fundamental shift in the drivers of agricultural productivity. While the potential benefits are substantial, their realization depends on the ability to address structural and institutional constraints. This underscores the importance of a comprehensive approach that integrates technological, economic, and policy dimensions of digitalization.

Conclusion. The purpose of this study was to evaluate the effectiveness of the digital transformation of agricultural enterprises and to develop ways to improve it using the example of the Kostanay region of the Republic of Kazakhstan. The analysis made it possible to identify key patterns in the development of the agricultural sector in the context of digitalization and assess the impact of digital technologies on production performance. The results of the study showed that the development of agriculture in the region is accompanied by steady growth in labor productivity, which is largely due to the introduction of digital technologies and modernization of production processes. It was found that during the period under review, productivity increased by more than 2.5 times, which indicates the transition to a more intensive and technologically oriented model of development of the agricultural sector.

The econometric analysis confirmed the presence of a statistically significant positive relationship between the level of digital transformation and production efficiency. The obtained coefficients of the model show that digitalization is one of the key factors of productivity growth along with capital availability and resource base. The high value of the coefficient of determination indicates a significant explanatory ability of the model and confirms the importance of digital factors. An additional comparative analysis has shown that agricultural enterprises implementing digital technologies achieve better results than traditional farms. In particular, productivity growth is 18-27%, and cost reduction is 12-15%. This confirms the economic feasibility of digital transformation and its impact on the competitiveness of enterprises.

However, the study revealed significant limitations and imbalances. Despite the

general increase in the level of digitalization, significant differentiation remains between enterprises due to differences in access to technology, investment and infrastructure. Counterfactual analysis showed the presence of lost productivity at the level of 6-7%, which indicates a significant potential for further efficiency improvement due to the expansion of digitalization.

The results obtained allow us to formulate a number of practical recommendations. Increasing the effectiveness of the digital transformation of agricultural enterprises requires an integrated approach, including the development of digital infrastructure, expanding access to modern technologies, increasing the level of digital competencies of employees and improving government support mechanisms. Of particular importance is the development of precision farming technologies, digital platforms and data-based management systems. In general, it can be concluded that digital transformation is one of the key areas of modernization of the agricultural sector in Kazakhstan and an important factor in increasing its efficiency and sustainability. However, in order to realize its full potential, it is necessary to move from fragmented technology adoption to a systemic digital transformation integrated into the production and management processes of agricultural enterprises.

References

Aghion P., and Howitt P. (1992) A model of growth through creative destruction. *Econometrica, 60*(2). — P. 323–351. https://www.jstor.org/stable/2951599 (in Eng.)

Becker G.S. (1993) *Human capital: A theoretical and empirical analysis, with special reference to education* (3rd ed.). University of Chicago Press. (in Eng.)

Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (2025) *Statistics of agriculture, forestry, hunting and fisheries*. https://stat.gov.kz/en/industries/business-statistics/stat-forrest-village-hunt-fish/ (in Eng.)

Food and Agriculture Organization of the United Nations (2022 *The State of Food and Agriculture 2022: Leveraging automation in agriculture for transforming agrifood systems*. Rome: FAO. https://doi.org/10.4060/cb9479en (in Eng.)

Gebbers R., and Adamchuk V.I. (2010) Precision agriculture and food security. *Science, 327*(5967). — P. 828–831. https://www.science.org/doi/10.1126/science.1183899 (in Eng.)

Hanushek E.A., and Woessmann L. (2008) The role of cognitive skills in economic development. *Journal of Economic Literature, 46*(3). — P. 607–668. https://doi.org/10.1257/jel.46.3.607(in Eng.)

International Telecommunication Union (2023) *Measuring digital development: Facts and figures 2023*. https://www.itu.int/itu-d/reports/statistics/facts-figures-2023/ (in Eng.)

Lowenberg-DeBoer J., and Erickson B. (2019) Setting the record straight on precision agriculture adoption. *Agronomy Journal, 111*(4). — P. 1552–1569. https://doi.org/10.2134/agronj2018.12.0779 (in Eng.)

Ministry of Digital Development, Innovations and Aerospace Industry of the Republic of Kazakhstan (2023) *Digital Kazakhstan*. https://www.gov.kz/memleket/entities/maidd/activities/14764 (in Eng.)

OECD (2019) *Digital Opportunities for Better Agricultural Policies*. Paris: OECD Publishing. https://doi.org/10.1787/571a0812-en (in Eng.)

Romer P.M. (1990) Endogenous technological change. *Journal of Political Economy, 98*(5, Part 2). — P. 71–102. https://doi.org/10.1086/261725(in Eng.)

World Bank (2019) *Future of Food: Harnessing Digital Technologies to Improve Food System Outcomes*. Washington, DC: World Bank. https://openknowledge.worldbank.org/entities/publication/52f37cc3-66c3-5fd0-aa51-85a5823c64f7 (in Eng.)

World Bank (2023) *Data-Driven Digital Agriculture*. Washington, DC: World Bank. https://thedocs.worldbank.org/en/doc/1a163904ccb86646bf2e5d3d6f427f3d-0090012023/related/WB-DDAG-FA-web.pdf (in Eng.)

World Bank (2024) *World Development Indicators*. https://databank.worldbank.org/source/world-development-indicators (in Eng.)

Zhang, Y., Wang, L., and Duan, Y. (2016) Agricultural information dissemination using ICTs: A review and analysis of information dissemination models in China. *Information Processing in Agriculture, 3*(1). — P. 17–29. https://doi.org/10.1016/j.inpa.2015.11.002 (in Eng.)

Karácsony P., Uralova A., Bekbossinova A., Konyrbekov M., and Valkó V. (2026) Analysis of production, fiscal, and external sector channels of economic growth in Kazakhstan's oil and gas sector. *Problems and Perspectives in Management, 24*(1). — P. 438–453. https://doi.org/10.21511/ppm.24(1).2026.33(in Eng.)

Rakhimberdinova M., Nurekenova E., Ordabayeva M., Saifullina Y., and Kuttybaeva N. (2022) Role of development of the agro-industrial complex to create areas of agritourism. *Journal of Environmental Management and Tourism, 13*(8). — P. 2311–2319. https://doi.org/10.14505/jemt.v13.8(64).16 (in Eng.)

Razakova D.I., Nurymova S.K., Khalitova M.M., Iskakov U.M., and Konyrbekov M. (2020) The role and significance of tax incentives in business activity and budget growth: Mediating role of supply chain management. *International Journal of Supply Chain Management, 9*(2). — P. 815–821. (in Eng.)

Kussainova A., Rakhimberdinova M., Denissova O., Taspenova G., and Konyrbekov M. (2018) Improvement of technological modernization using behavioral economics. *Journal of Environmental Management and Tourism, 9*(7). — P. 1470–1478. https://doi.org/10.14505/jemt.v9.7(31).13 (in Eng.)

Tekenov U. A., Daurenbekova A.N., and Konyrbekov M.Z. (2017) Current state and prospects of development of the agro-industrial complex of animal husbandry in Kazakhstan. *Espacios, 38*(49), 19. (in Eng.)

Konyrbekov M.Z. (2015) Studying the features of livestock sector growth in Kazakhstan within market environment. *Actual Problems of Economics, 169*(7) — P. 79–87. (in Eng.)

Publication Ethics and Publication Malpractice in the journals of the Central Asian Academic Research Center LLP

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the journals of the Central Asian Academic Research CenterLLP implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier. com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The Central Asian Academic Research Center LLP follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http:// publicationethics. org/files/ u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/ or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the Central Asian Academic Research Center LLP.

The Editorial Board of the Central Asian Academic Research Center LLP will monitor and safeguard publishing ethics.

Requirements for articles design for publication in the journal are available on the websites:

www: nauka-nanrk.kz
ISSN 2518–1467 (Online),
ISSN 1991–3494 (Print)
http://www.bulletin–science.kz/index.php/en

Managing Editor: A.Shormakova
Editors: D.S. Alenov, M.Konyrbekov
Computer layout: G.D. Zhadyranova

Подписано в печать 27.04.2026.
46,0 п.л.
Заказ 2.

«Central Asian Academic Research Center» LLP
Алматы, Шевченко к-сі, 28